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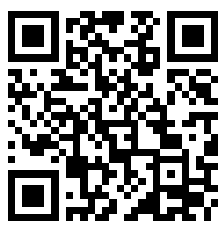

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VOL. XXXVI.

JANUARY TO JUNE

1915.

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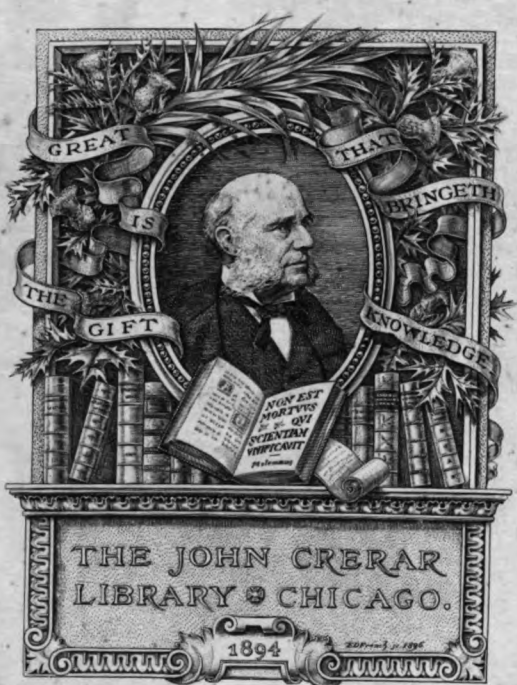

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"NORTHWARD-BOUND."

Leaving Euston Station, London, for Scotland.

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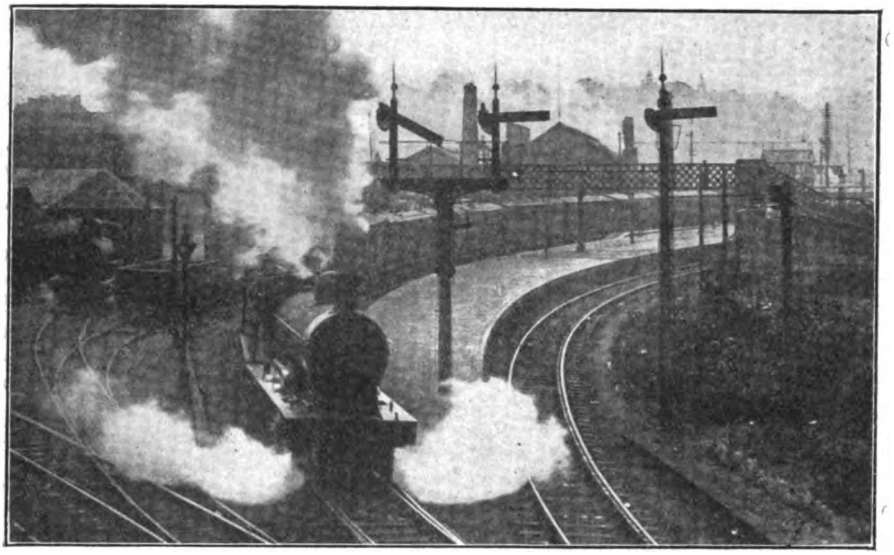

Photo] [*A. M. Nicol.*

HIGHLAND RAILWAY.

9.50 a.m. Wick and Thurso train leaving Inverness.

Express Train Facilities on Scottish Railways. [No. I.].

By J. FRANCIS.

SCOTLAND has nearly 4,000 miles of railway. provided by the five companies which constitute together virtually the whole of its railway system. Two of these companies (North British and Caledonian) each possess over 1,000 miles of line, while the Glasgow and South Western and Highland Railways both nearly reach 500 miles and the Great North of Scotland possesses well over 300 miles. It follows then that the passenger traffic operated over the principal routes is by no means a secondary factor in the work of British railways, while the industrial, mineral and general merchandise traffic reaches very large tonnages in the course of the year. In fact, the Glasgow and Edinburgh districts alone provide occasion for comprehensive train services on a large scale, while Dundee, Aberdeen, and in a different way Perth, Inverness, Dumbarton, Motherwell, Coatbridge, Dunfermline, Kilmarnock, Galashiels, Greenock, etc., together call for a great deal of inter-communication traffic in meeting the transportation requirements of the Northern Kingdom, industrially and commercially, as well as from the tourist point of view.

One may say that, however great the tourist traffic from and to England and in Scotland itself, it is yet a very secondary matter as compared with the standard traffic required to meet the commercial, industrial and general travel demands of North Britain; and it is mainly from this aspect that this article has been prepared. That is, the inter-town, inter-district, residential and other all-the-year-round facilities will receive principal attention, instead of giving pride of place to the Anglo-Scottish services, though the latter must, of course, be adequately considered as they exercise a very strong influence upon a large proportion of the purely Scottish facilities.

As a convenient means for carrying out this scheme of consideration, it is thought preferable to utilise the winter timetables as a basis, instead of giving special attention to the amplified summer services, as is usually done; and this is the more convenient in that, when analysed, so many of the special tourist and holiday developments show themselves to be largely in the nature of reliefs to, or divisions of, trains which run winter and summer alike,

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more or less accelerated to suit requirements, as the main train is still available to maintain standard arrangements. In fact, it will be found that the only important Anglo-Scottish trains which cannot be thus allocated, are those leaving London between 11 a.m. and 12 noon and the Scottish capitals about mid-day.

All the others can be quickly dismissed by a brief analysis, before dealing with the essentially Scottish express services. Taking first the Caledonian route from Carlisle the following trains may be specially noted:

FROM CARLISLE (CALEDONIAN RAILWAY).

2.20 a.m.*	8 p.m. *ex*-Euston, exclusively for Stirling, Perth and Aberdeen and routes radiating from these stations. Non-stop to Stirling or Perth.
4.22 a.m.	8.50 p.m. *ex*-Euston, 10.55 p.m. *ex*-Birmingham, 12.45 a.m. *ex*-Liverpool, Glasgow and Edinburgh secondary express, also semi-fast on Perth route. Calls at Lockerbie, Beattock (†), Carstairs, Law Junction (†), and Eglinton Street (†) to Glasgow.
5.50 a.m.	11.45 p.m. *ex*-Euston. Special express for Edinburgh, with portion for Aberdeen attached later to train from Glasgow.
6.5 a.m.	12 midnight *ex*-Euston. Special Glasgow express, non-stop.
12.42 p.m.	5 a.m. *ex*-Euston, 7.15 a.m. *ex*-Birmingham, 9.47 a.m. *ex*-Liverpool, 9.45 a.m. *ex*-Manchester. Primarily a Liverpool and Manchester express to Glasgow, calling at Symington and Carstairs, with connection to Edinburgh.
1.30 p.m.	Semi-fast in connection with preceding trains, mainly for the Perth route and with Glasgow connection from Motherwell.
3.30 p.m.	7.10 a.m. *ex*-Euston, 9.15 a.m. *ex*-Birmingham, 12.17 p.m. *ex*-Liverpool, 12.40 p.m. *ex*-Manchester. Primarily Liverpool and Manchester train. Calls five times to Glasgow.
3.55 p.m.	Glasgow portion of 10 a.m. *ex*-Euston. Calls at Symington only.
4.5 p.m.	Second portion of 10 a.m. *ex*-Euston, for Edinburgh. Aberdeen portion detached at Symington.
8.10 p.m.	Glasgow and Edinburgh portion of 2 p.m. *ex*-Euston, with connections from Birmingham, Liverpool and Manchester.
8.48 p.m.	5.50 p.m. *ex*-Liverpool, 5.45 p.m. *ex*-Manchester for Glasgow and Edinburgh, with portion (off 2 p.m. *ex*-Euston) for Perth and Aberdeen.

Of these trains the 6.5 a.m. is the only actual non-stop, all others including at least one call for division or other purposes, and it is notable that although all except the 1.30 p.m. reach Glasgow or Edinburgh in 2½ hours from Carlisle, or less, most of them call two or more times, thus showing that they possess branch or connection importance, as well as for through traffic, while several serve industrial centres such as Motherwell and (usually by the Perth portions) Coatbridge.

While dealing with this route it will be convenient to refer to the 7.15 a.m. from Symington (7.30 a.m. from Biggar), fast from Law Junction or Wishaw (South) to Glasgow (due 9 a.m.); the 7.49 a.m. from Beattock (7.42 a.m. from Moffat), the well-known "Tinto" express, non-stop except Motherwell (to set down) from Thankerton to Glasgow (due 9.32 a.m.), and with a fast portion from Symington to Edinburgh on Mondays; and the 8 a.m. *ex*-Beattock, fast except Wishaw and Motherwell from Carstairs, due Glasgow 10 a.m. These three trains cater for the developing long-distance residential and week-end traffic to and from Glasgow, in view of the special favour possessed by stations between Moffat and Thankerton, with the Biggar and Peebles branch (served by connections or through portions), for business men engaged in Glasgow and Motherwell. The journeys involved amount to only 47 min. from Thankerton (by the "Tinto" express), so that the times given are quite practicable. Edinburgh, too, gets a portion of the "Tinto" express on Mondays, while its portion of the 8 a.m. *ex*-Beattock is due at Princes Street at 9.53 a.m., 7 min. earlier than the Glasgow portion.

The 9.5 a.m. secondary train from Carlisle may also be noted, together with the 6.10

* For convenience times are given as in the public timetables and in the case of the Caledonian services no account is made of calls at Beattock or Beattock Summit when assistance is taken.

† Conditional stops.

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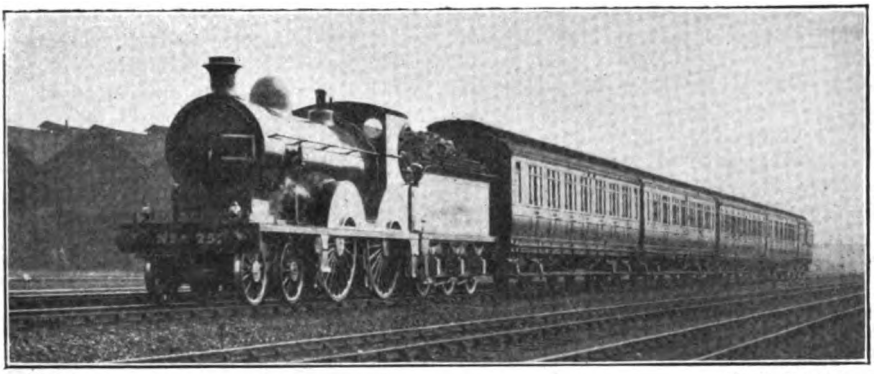


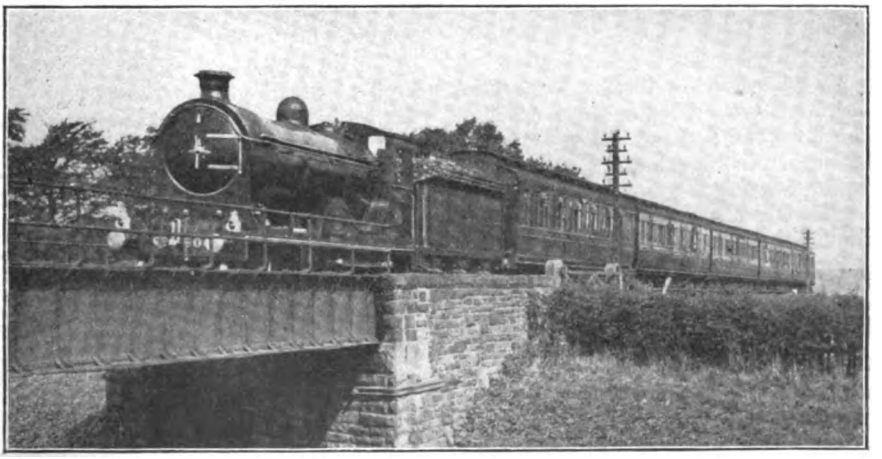
Photo] [*F. E. Mackay.*

GLASGOW AND SOUTH WESTERN RAILWAY.
St. Pancras-Glasgow Express. 4–4–0 locomotive No. 252.

p.m. from Carlisle, and the 5.20 p.m. Sunday semi-fast to Glasgow, as interesting features of the train services on this section. Between Carstairs and Glasgow there are numerous semi-fast trains for business travel, especially for Cleghorn and Carluke, while the town of Lanark has good residential trains at 8 and 8.35 a.m., due in Glasgow under the hour, the latter also having a good connection from the Muirkirk and Douglas route, and giving a good service to Edinburgh.

Southbound trains arriving at Carlisle may be more rapidly reviewed.

12.5 p.m.	10.5 a.m. *ex*-Edinburgh, the fastest train on the Caledonian. Booked in two hours with two conditional stops. For Birmingham, Manchester, Liverpool and London.
12.12 p.m.	10.0 a.m. *ex*-Glasgow. Conditional call at Motherwell. For Birmingham and London.
12.33 p.m.	10.10 a.m. *ex*-Glasgow, for Manchester and Liverpool.
12.51 p.m.	6.40 a.m. *ex*-Aberdeen, for Liverpool, Manchester, Birmingham and London.
4.5 p.m.	10.5 a.m. *ex*-Aberdeen, for London, Manchester, Liverpool, and Birmingham, joined at Symington to the 2 p.m. from Edinburgh.
4.15 p.m.	2 p.m. from Glasgow (non-stop), for London, etc.
6.59 p.m.	4.30 p.m. from Glasgow, with Edinburgh connection, mainly for Liverpool and Manchester.
8.33 p.m.	1.10 p.m. from Aberdeen, 5.55 p.m. from Glasgow and 6 p.m.



Photo] [*F. E. Mackay.*

NORTH BRITISH RAILWAY.
Edinburgh-St. Pancras express near Carlisle.

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from Edinburgh, combined at Law Junction and Carstairs, for the south.

11.35 p.m. 9.5 p.m. from Glasgow and Edinburgh, for Birmingham and London.

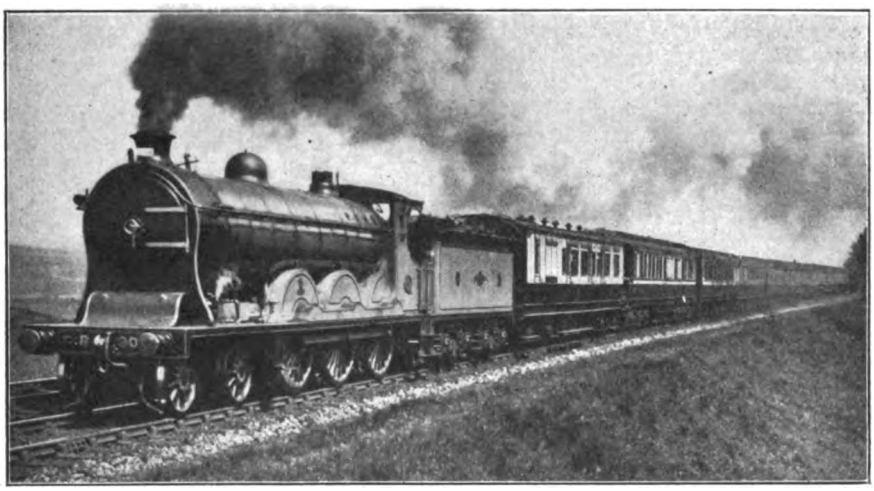
12.7 a.m. 5.45 p.m. from Aberdeen, etc., for the south.

12.55 a.m. 10.45 p.m. from Glasgow and 10.50 p.m. from Edinburgh, for the south. This is the principal night sleeping car express for London.

1.44 a.m. Aberdeen, Glasgow and Edinburgh express, for London, Liverpool and Manchester.

Similar remarks to those made in reference to the comprehensive work of down trains the 5 p.m. "Tinto" express to Beattock and Moffat; a connection from Carstairs to Symington and Biggar off the 5.55 p.m. from Glasgow and the 6 p.m. from Edinburgh; and the 9.55 a.m. Sunday express from Glasgow to Carlisle and England. On the Lanark route the 1 p.m. and 1.25 p.m. trains from Glasgow on Saturdays, and the 4.30 p.m. service by slip carriage at Carluke and the 5 p.m. slip at Cleghorn for Lanark off the "Tinto" express, may be noted.

In the case of other railways the services on the Anglo-Scottish routes are simpler, as there is a more definite differentiation of traffic. Taking the Glasgow and South Western Railway from Carlisle, the principal trains from Carlisle are the 3.10 a.m.—from Euston, Manchester, Liverpool, Newcastle,



Photo] [*A. M. Nicol.*

CALEDONIAN RAILWAY.

10 a.m. Glasgow-London express, 4-6-0 locomotive No. 906.

also apply to certain of these. In addition may be noted the 1.20 p.m. from Glasgow on Saturdays, the return "Tinto" express for stations from Thankerton to Beattock and Moffat, with a fast portion from Edinburgh at 1.10 p.m. to Symington; the 2.3 p.m. semi-fast from Glasgow to Carlisle, which by means of regular or conditional calls virtually forms a second "Tinto" express for long-distance residential stations, also with a good Edinburgh connection; the 4 p.m. from Glasgow to Carstairs, continued except on Saturdays to Elvanfoot and Beattock, thus catering for similar traffic on days other than Saturdays (on that day similar facilities are given off the 4.30 p.m. *ex*-Glasgow and the 4.15 from Edinburgh); etc., to Stranraer (operated semi-fast from Dumfries over the Portpatrick and Wigtownshire Joint Railway), also semi-fast to Glasgow; and the 4.40, 6.30 a.m. (breakfast car from Carlisle to Glasgow), 12.50 p.m., 4.2 p.m., 5.55 p.m. and 7.58 p.m. (this is the fastest down train on the route, its calls at Annan, Dumfries and Kilmarnock being conditional). All these trains call at Dumfries and Kilmarnock, regularly or conditionally, and some of them at Annan also. Besides their through portions or connections from London, Birmingham, Liverpool Manchester, Leeds, etc., it may be noted that some of them have Bristol carriages. All other trains are of a stopping character south of Kilmarnock, but the

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8 a.m. from New Cumnock may be noted as catering for residential traffic.

In the opposite direction the 9.20 a.m., 11 a.m., 1.30 p.m. (this is the fastest up train, the call at Dumfries being a conditional one only), 5.30, 9.30 and 11 (or 11.15) p.m. expresses may be noted, all except the 11 p.m. (except Saturdays, omits Dumfries) however, serving Kilmarnock and Dumfries, and in some cases Annan also. The return Stranraer night train leaves Dumfries at 12.2 a.m. As regards intermediate traffic several trains in this direction omit a few of the country stations (though none do the other way, except one or two which pass Hurlford); and the 1.35 p.m. on Saturdays to Dumfries, the 2.30 p.m. ordinary train, the 4.17 p.m. for Dumfries, and the 5.35 p.m. to New Cumnock (on Saturdays to Dumfries), may be said to cater for residential traffic as far as required.

The North British route from Carlisle to Edinburgh may be similarly dismissed briefly. The 4.28 a.m. is the principal night express *viâ* the Midland route and calls at Hawick, St. Boswells and Galashiels only to Edinburgh. The next express is, in winter, the 1 p.m., calling seven times and reaching Waverley at 3.55 p.m., while on Saturdays the 3 p.m. from Carlisle (then run as a semi-fast to Riccarton Junction) continues as a semi-fast to Edinburgh, though for through traffic it is passed by the 3.55 p.m. non-stop express, due at Waverley at 6.10 p.m. The 5 p.m. semi-fast to Langholm is of interest, as catering for special Saturday traffic, while the 6.12 and 8.2 p.m. trains complete the list of expresses over the whole of this route. Of a residential character, however, the 6.40 and 8.8 a.m. trains from Hawick (the latter particularly) may be noted, while throughout the day Galashiels, as an important town and junction, has a good series of expresses with Edinburgh.

In the southbound direction the 9.30 a.m. from Waverley is the principal morning express, its calls at Galashiels and Hawick being conditional only; the 10.30 a.m. is another good train for the south; the 1.5 p.m. is a fairly good residential train for stations to Hawick; the 2.15 p.m. is the principal afternoon express for the south, its calls at Galashiels and Hawick again being conditional, though Galashiels gets a good non-stop from Edinburgh at 2.35 p.m. and this constitutes an express for various stations beyond; the 4.25 p.m. is non-stop to Fountainhall; the 6 p.m. is an express for Galashiels, Melrose, Hawick and the south; while the 10 p.m. night express also serves Galashiels, Melrose and Hawick. Between Gorebridge and Edinburgh there are several fast local trains serving residential traffic, but these cannot be considered in detail; and the same remark also applies to certain other routes out of Edinburgh. In summer there are several important additions to the train services on this route; but those noted constitute the winter standard.

Dealing now with the Berwick-Edinburgh section, the Anglo-Scottish services are amplified by several facilities of Scottish interest. In winter only the 1.21, 2.59 and 11.14 a.m. trains from Newcastle are non-stop to Edinburgh, the last-mentioned, a Leeds-Glasgow express, being the fastest; but Berwick has non-stops to Edinburgh at 4.43 a.m., and 4.56 and 9.32 p.m. From Dunbar to Edinburgh may be said to constitute a residential area, with the North Berwick, Gullane and Haddington branches, and from this point of view may be noted the 7.10 a.m. from Dunbar; the 7.28 a.m. from Berwick (conveys a sleeping car from London for intermediate stations in Scotland, and calls at Reston, Dunbar and Longniddry, with connections from Gullane and Haddington), due Waverley 8.58 a.m.; the 8.41 a.m. special express from North Berwick, due Waverley 9.24 a.m.; and the 8 a.m. from Reston. Other interesting trains from Berwick are the 11.20 a.m., calling at Reston and Dunbar only; the 2.5 p.m., calling at Dunbar; the 7.28 p.m. also serving Dunbar; and the 5.52 p.m. Sunday train, calling at Dunbar on the journey from Leeds, York and Newcastle to Edinburgh and Glasgow

North Berwick has several other good trains on its own account, the 10.50 a.m., 6.28 p.m. (Saturdays only), and 9.15 p.m. (Saturdays only) being more or less fast, while on Thursdays the 9.47 p.m. calls only at Prestonpans and Portobello, reaching Waverley at 10.26 p.m. In summer the "Lothian Coast" express leaves Dunbar at 7.55 a.m., and North Berwick and Gullane at 8 a.m., reaching Waverley at 8.43 a.m. and Glasgow at 9.46 a.m.

In the opposite direction the 11.15 p.m. sleeping car express from Waverley is the only one to pass Berwick (in winter) without calling, but the 10 a.m., 2.20 and 6.25 (return Glasgow and Edinburgh to Leeds express) are non-stop to Berwick, while the 7.45 a.m. and 10.50 p.m. call only at Dunbar.

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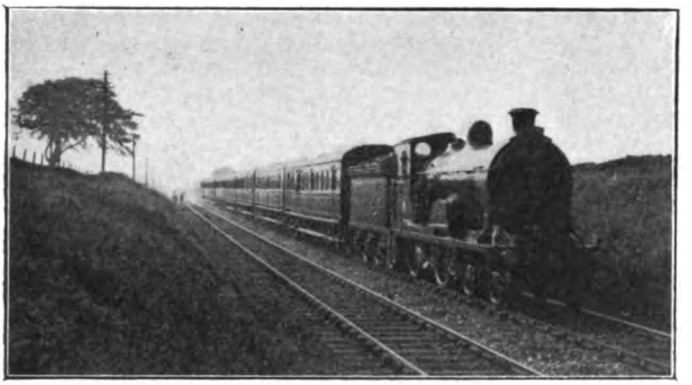

Photo] [*R. F. Robertson.*

NORTH BRITISH RAILWAY.

"Lothian Coast" Express, 4-4-0, locomotive *Rob Roy*.

The 10.20 a.m., and 2.53 p.m. (fast to Dunbar), are good trains for the whole of the Edinburgh-Berwick route; while the 9.46 a.m. (first stop Drem), 1.36 (Saturdays only, calling at Inveresk), 4.45 p.m. (first stop Longniddry), 8.10 p.m., 10.20 p.m. (Saturdays only), and the 11 p.m. (Thursdays only) are the special North Berwick trains, all very creditably fast. Other useful services for residential traffic are the 1.45, 4.1, 5.18 and 6.30 p.m. trains. In summer the east-bound "Lothian Coast" express replaces the 1.36 p.m. from Waverley, on Saturdays, but on other days constitutes an independent train at 4.55 p.m. The whole of the train service on the Gullane and North Berwick route is, however, considerably amplified. The special Sunday express for England is the 12 noon from Waverley, non-stop to Dunbar and Berwick.

Having thus reviewed as briefly as possible, though necessarily at considerable length, the main routes from Carlisle and Berwick to the capital cities, it will be most convenient to deal with those connecting Edinburgh and Glasgow, still on the basis of standard winter schedules. Necessarily there is a constant stream of traffic passing between these cities, partly due to the fact that many Glasgow business men reside in Edinburgh and travel to and fro daily, but also including journeys either way on other grounds spread over the day, and especially at the commencement and conclusion of business hours, and in the neighbourhood of 1 o'clock so as to connect with commercial activities after lunch time. In fact, quite a considerable trade is done on the restaurant car services in the route after midday as the journey time can thus be profitably utilised, and this applies not only to the North British services, where ordinary restaurant accommodation is provided, but also to those on the Caledonian route where Pullman buffet cars are now employed.

The Caledonian Edinburgh - Glasgow trains are, however, virtually distinct from others, whereas on the North British route the trains are associated with Anglo-Scottish traffic and the cars have thus a wider usefulness, and in some cases cater for intercapital traffic more or less incidentally. The local traffic is, however, itself a very large factor, hence the adequate provision made by the Caledonian Company, with special set trains therefor—in accordance with the usual Caledonian practice of reserving sets of vehicles for specific services, the carriages often being permanently lettered therefor, instead of using detachable boards—while on the North British route the considerable efflux of passengers on arriving at Edinburgh from Glasgow is quite a notable feature of certain trains. Both routes also have a degree of intermediate importance, hence the stops given to certain of the express trains.

Taking first the Caledonian route, there are now 8 or 9 services with Pullman buffet cars*. The first from Edinburgh is, however, by a secondary train from Princes Street at 6.25 p.m., but the 9, 10.55 a.m., 12.55, 3.55, 4.55, 7.5 and 9.50 p.m. are good trains.

The following analysis will be of interest:

FROM PRINCES STREET.

9.0 a.m.	65 min.	Merchiston only.
10.55 a.m.	70 ,,	Eglinton Street only.
12.55 p.m.	70 ,,	Merchiston on Wednesdays, Shotts on Saturdays, Eglinton Street every day.
2.20 p.m.	—	(Sats. only). Semi-fast.
3.55 p.m.	70 ,,	Eglinton Street only.
4.55 p.m.	73 ,,	Merchiston, Holytown, and Eglinton Street.

* These were described in the July, 1914 RAILWAY MAGAZINE.

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7.5 p.m. 67 ,, Merchiston and Eglinton Street.
9.50 p.m. 65 ,, Shotts, Eglinton Street (Sats. only).

It is interesting to note that Shotts is served on Saturdays by the 12.55 and 9.50 p.m. expresses, while the 2.20 (Sats.), 3.57 p.m. and certain other slower or more local trains cater to some extent for residential traffic at Westcalder, Fauldhouse and Shotts and business traffic at Holytown. In some cases the calls at Merchiston or Eglinton Street are to pick up or set down only, but only the 9.50 p.m. is actually non-stop, except on Saturdays. On Sundays there are now two secondary trains from Edinburgh to Glasgow, at 9 a.m. and 6.10 p.m.

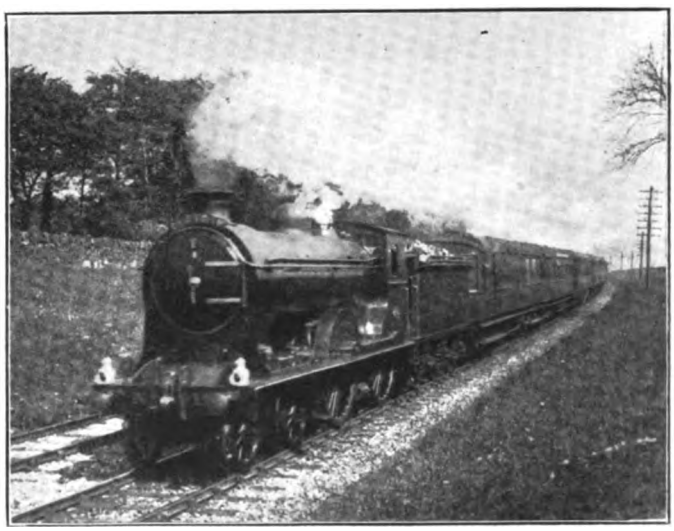
From Glasgow all the best services have Pullman buffet cars, the expresses being as follows :

FROM GLASGOW (CENTRAL).

8.45 a.m. 75 min. Eglinton Street, Holytown and Merchiston.
9.50 a.m. 78 ,, Eglinton Street, Holytown and Merchiston.
11.0 a.m. 76 ,, Eglinton Street, Holytown and Merchiston.
1.30 p.m. 65 ,, Not Saturdays. Not-stop.
1.30 p.m. 76 ,, Westcalder and Merchiston.
2.20 p.m. — Semi-fast.
4.5 p.m. 71 ,, Holytown and Merchiston.
5.10 p.m. — Semi-fast
6.45 p.m. 75 ,, Saturdays only. Holytown and Merchiston.
6.45 p.m. 80 min. Not Saturdays. Holytown, Shotts, Fauldhouse and Merchiston.
10.20 p.m. 78 min. Eglinton Street, Holytown, Shotts (Wednesdays only) and Merchiston.

There are also more or less fast trains at 8.10 and 9.7 p.m. It must be remembered that although the best time for the 46¼ miles is 65 minutes non-stop, the route is a complicated one and the gradients very severe in places. The Sunday trains leave Glasgow at 11.10 a.m. and 8.15 p.m., again semi-fast at each end of the journey.

As already indicated the North British services between Edinburgh and Glasgow are associated with other services, so that a more comprehensive series of trains is called for. The best is now the 4 p.m., allowed 63 min., with a call at Haymarket, though the summer " Lothian Coast " expresses are booked in the hour without stop, but the 4.30 a.m. (usually a light train off the 8 p.m. *ex*-King's Cross), 9.5 a.m. (in special favour for residential traffic across to Glasgow), and the 1.5 p.m. (the chief mid-day train, with restaurant cars from Leith to Glasgow), are 65-min. trains calling only at Cowlairs (4.30 a.m.) or at Haymarket in the case of the other trains noted. Remaining expresses call at least once more. Thus the 6.10 a.m. (off the 8.45 p.m. *ex*-King's Cross) serves Linlithgow (Mondays only), Polmont, Falkirk and Cowlairs, taking 73 min. ; the 7.21 a.m. (Mondays only, off the 9.30 p.m. *ex*-St. Pancras), calls 6 times and takes 85 min. ; the 7.40 a.m. breakfast car train (off the 11.30 p.m. *ex*-King's Cross) on Mondays calls at Haymarket and conditionally at four other stations, taking 78 min., but usually serves the same five stations regularly, and is then allowed 85 min. ; the 10.6 a.m. stops at Haymarket and Polmont and takes 69 min. ; the 11.25 a.m. is a Saturdays only 67-min. train calling at both Haymarket and Cowlairs ; the 1.52 p.m. is the continuation of the special Leeds-Glasgow train previously referred to and stops three times,



Photo] [*R. F. Robertson.*

NORTH BRITISH RAILWAY.

1.52 p.m. Edinburgh-Glasgow Express, with through carriages from Leeds and Newcastle.

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taking 76 min.; the 5 p.m. (a favourite train) is allowed 76 min. with three regular stops and a set-down call at Lenzie; the 6.28 p.m. connects with the 9.30 a.m. *ex*-St. Pancras and the 10 a.m. *ex*-King's Cross, and has restaurant cars, its allowance of 67 min. including conditional calls at Polmont and Lenzie; while the 9.15 p.m. (74 min. with two regular and one conditional call) is really an extension of the useful 10.35 a.m. *ex*-King's Cross. There are several other fairly creditable trains, such as the 9.35 a.m., 1.28 p.m. (Saturdays only), and the 10.10 p.m. (Saturdays only), on this route. On Sundays there is an interesting express at 8.30 p.m. from Waverley calling only at Falkirk and reaching Queen Street at 9.40 p.m., and this follows the 7.45 p.m.

1.0 p.m. Mid-day restaurant car express, 66 min. Calls at Haymarket only. Connects with 2.20 p.m. to King's Cross.

2.10 p.m. (Saturdays only). 74 min. 3 stops.

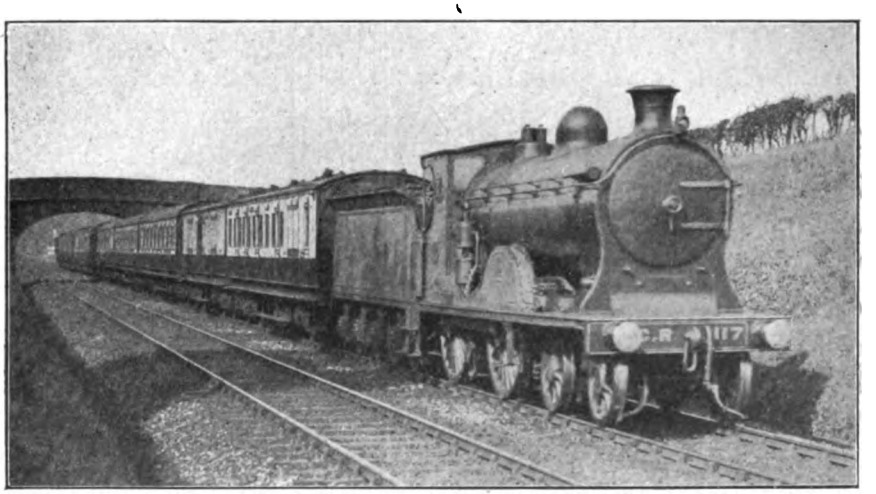
2.10 p.m. (Not Saturdays). 81 min. 5 stops.

4.0 p.m. 65 min. 2 stops. Restaurant car.

5.0 p.m. Return Leeds express. Restaurant car. 72 min. 3 stops. Connects with 6.25 p.m. to Newcastle and Leeds.

6.0 p.m. 83 min. 4 or 5 stops. Restaurant car.

8.20 p.m. 74 min. 3 stops. Connects with St. Pancras train.



Photo] [*F. E. Mackay.*

CALEDONIAN RAILWAY.
Perth-London express.

train booked to Glasgow in 76 min. with 4 stops. The latter is a continuation from York and Newcastle, but the former is more or less an isolated express.

In the opposite direction the principal trains from Glasgow are as follows:

7.45 a.m. 78 min. 4 stops. Connects with 9.30 a.m. express from Waverley to St. Pancras.

8.40 a.m. 71 min. 2 regular stops and one conditional. Connects with 10 a.m. to King's Cross.

10.5 a.m. 77 min., except Wednesdays (3 stops). 83 min. on Wednesdays (5 stops).

11.0 a.m. 68 min. 2 stops.

12.37 p.m. (Saturdays only). 68 min. 2 stops.

9.35 p.m. 65 min. 1 conditional stop. Serves the 10.50 p.m. night express from Waverley to King's Cross.

There are also creditable trains at 2.22 p.m. (Saturdays only), and 7 p.m., with the 10.30 p.m. semi-fast on Saturday nights. On Sundays the 10.25 a.m. express in 75 min. (3 stops) may be noted, while the 7.50 p.m. is a good train replacing the 8.20 p.m. on weekdays but with 5 stops, and the 9.35 p.m. from King's Cross is then booked non-stop, though allowed the 65 min. as on weekdays. It is interesting to observe that although there is a good service throughout every weekday between Edinburgh and Glasgow, yet quite a number of the expresses have to meet the requirements of Falkirk, Polmont,

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Manuel and Linlithgow, or some of these stations. There is indeed a combination of residential and commercial traffic on this route, applying to principal stations intermediately as well as over the complete route.

Before proceeding northwards it will be convenient to deal with other services which apply particularly to Edinburgh and Glasgow, omitting for the present those proceeding north of the inter-capital main lines. In the case of Edinburgh there is not much to remark upon, as the main line services towards Gullane, North Berwick, Dunbar, Galashiels, Carstairs and Lanark have already received as much attention as is necessary without going into elaborate detail; while space will not permit of the more particularly local and suburban facilities being dealt with. This dismisses the North British services from Edinburgh to Penicuik and Glencorse, to Galashiels *viâ* Leadburn and Peebles, and the Leith and Granton routes, though the Bathgate route between Edinburgh and Glasgow has several fairly good trains, notably the 8.15 p.m. from Waverley (due Queen Street 9.53 p.m.) and the 7.50 a.m. *ex*-Queen Street. The 40-min. express from Carlisle at 11.50 a.m. to Silloth on Thursdays and Saturdays may be noted as an interesting inclusion in a somewhat unexpected district.

Most of the Glasgow routes, except to the north, are mainly of a suburban character, or are included in the wonderful network of lines serving the busy industrial districts adjoining; but certain specific sections present considerable material of interest, notably those towards the Clyde and Ayrshire coasts. In the case of the Caledonian Railway there are some good trains *viâ* the Barrhead joint line, such as the 9 a.m. from Kilmarnock and the 10.20 a.m. to Kilmarnock from Central station. The Princes Street-Carstairs route also gives several good trains of residential interest.

To Ardrossan the chief features of interest are provided by the steamer trains operated during the summer, and then we find the 8.50 (Portrush and Arran express), 9.15 (Belfast express), 11 a.m.(Isle of Man boat express, Mondays and Wednesdays), 12.40 (not Saturdays), 1.6 (Arran boat train, Saturdays only), 5.10 (not Saturdays), 10.50 (Fridays only), and 11 p.m. (Belfast night mail), all as really good expresses over a distinctly hard road. All complete the journey of 31¾ miles to Ardrossan Pier in the hour or less, the 9.15, 11 a.m. (one conditional stop) and 11 p.m. (one conditional stop) being booked in 52 min. without stop except as noted; while the 8.50 a.m., 5.10 p.m. and 10.50 p.m. are 55-min. trains. Returning there are corresponding boat expresses from Ardrossan Pier at 3.20 (50 min.), 6.50, 8.15 a.m., 2.55, 4.10, 8.30 and 9 p.m. The December timetables, however, show only the 5.10 p.m. (except Saturdays), and the 11 p.m. Belfast night mail as expresses from Glasgow, with the 3.20 a.m. (Belfast night mail), 7.45 a.m., 8.25 a.m. and 8.25 p.m. (Saturdays only, Belfast express) as expresses or semi-fast.

Other steamer routes show similar characteristics. Thus, to Wemyss Bay there are Caledonian expresses from Glasgow at 8.55, 9.30, 10.30 a.m., 1.4 (Saturdays only), 1.15 (Saturdays only), 2.20 (Saturdays only), 4.30 (not Saturdays), and 5.12 p.m. in summer, while in winter the list is reduced to 1.15 p.m. (Saturdays only), with, however, most of the numerous semi-fasts, which also possess local and residential importance, remaining. On this route in summer the 1.4 p.m. (Saturdays) calls only at Inverkip while other trains noted call at Paisley only, the usual allowance being 53-57 min. for the difficult route of 31 miles, the work being largely performed by 0–6–0 goods engines or the intermediate 4–6–0 class. The Wemyss Bay route is, in fact, treated almost on a distinct basis, nearly all trains being more or less fast to Port Glasgow or Upper Greenock, so that even the slowest trains do not take much over the hour for the journey, except by the 7.10 and 8.35 p.m. winter trains from Glasgow which serve Wemyss Bay by connecting trains from Port Glasgow.

In the opposite direction facilities correspond with, in summer, an 8 a.m. (not Mondays) actual non-stop in 50 min., and numerous trains in 53-65 min. In winter the 8.42 a.m. train from Wemyss Bay, 56 min. with two regular and one conditional stop, is the best up service.

In the case of the Gourock route similar characteristics are evidenced, summer and winter schedules being radically different as regards the steamer services, though otherwise standard features may be traced all the year round. Here also a majority of the fast trains call at Paisley, other stations which receive special attention being usually Port Glasgow and one or both of the Greenock stations, with a few instances where suburban traffic is catered for *en route*. Even in summer there are no actual non-stops between Glasgow Central and Gourock, but in view of the difficulties of the route, often

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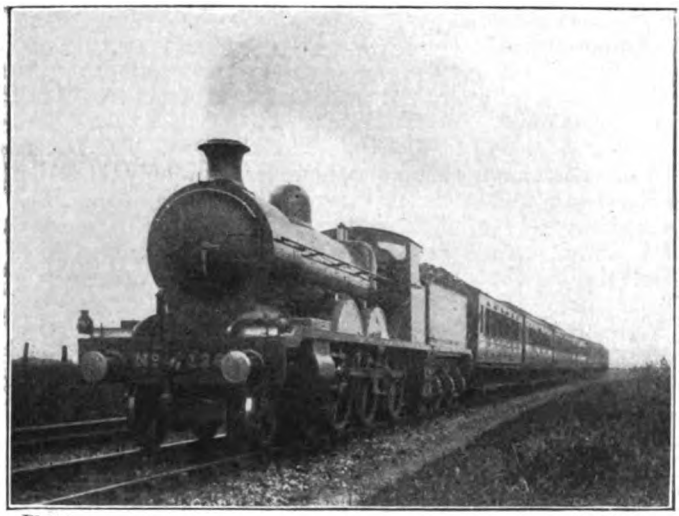

Photo] [*J. Cheyne.*

GLASGOW AND SOUTH WESTERN RAILWAY.

11.10 a.m. Glasgow-Liverpool Express, near Barrhead. 4-6-0 locomotive No. 126.

with very heavy trains made up of standard sets reserved for this traffic with additional vehicles as required, the schedules of 43 or 44 min., with one stop, given to many trains are distinctly creditable.

The 8.35 a.m. is interesting in that it stops (to set down) only at Port Glasgow, to suit business requirements; the 9.50, 11 a.m., 1.20 (Saturdays only), and 5.20 p.m. down trains all make the Paisley stop only. The 1.9 and 2.14 p.m. Saturday expresses serve West Greenock only; but there are quite a number of trains—5.35, 8.12, 10.35 a.m., 2.55, 4.18, 6.25, 9.5 (Saturdays only) and 10.10 (Saturdays only) p.m.—which call at Pollokshields (certain trains only), Paisley, Port Glasgow, and one or both of the Greenock stations. There are also several which serve one or more intermediate stations, though fast for the principal stages of the journey, such as the 1.50 p.m. (not Saturdays), 2.15 p.m. (not Saturdays), 3.45, 5.25 (not Saturdays), 6.30, 8.35, 10.40 and 11.15 p.m. trains. The 7.53 a.m. train from Holytown, Uddingston, Cambuslang and Rutherglen, to Paisley and non-stop to West Greenock and Gourock may also be noted.

Somewhat curiously, though the explanation is obviously the more varied character of the requirements, there are only two up expresses from Gourock to correspond with the best down trains, these being the 8.10 a.m. (non-stop to Pollokshields in 37 min., and on Mondays only) and the 8.15 a.m., calling at Paisley and (to set down) at Pollokshields. All other fast trains call at least four times to Glasgow, the principal being the 7.36, 8.38 (50 min.), 10.25 a.m., 12.45, 1.20 (Saturdays only), 2.50, 4.40, 4.50, 5.25 (not Saturdays), 5.45, 6.10, 6.30, 6.50 (Saturdays only), 7.40, 7.50, 8.10 (Saturdays only), 8.35 (Saturdays only), 9.5 (Mondays and Saturdays), 9.40 (Tuesdays and Thursdays), and 9.55 (Wednesdays and Saturdays) p.m. Perusal of this list indicates the peculiar character of this traffic, associated as most of it is with the Clyde steamer traffic. In fact, it well repays critical examination on that basis, but space cannot be devoted thereto on this occasion. There are three down trains on Sundays, 7.30 a.m., 11 a.m., and 6.55 p.m., all calling at Paisley, Port Glasgow and Greenock Central only, except that the two former pick up also at Pollokshields. Returning there are four, 2.10, 4.40, 7.30 and 8.20 p.m., calling at the same principal stations, and the three last at Pollokshields also, while the 4.40 p.m. gives Langbank its only train on Sunday. These again are mainly steamer trains.

Consideration of other sections of Scottish traffic must be held over until next month, but in concluding this instalment mention may be made of a new arrangement recently instituted by the Highland Railway. A new special express has been added, leaving Perth at 11.45 a.m. on Fridays and booked non-stop to Kingussie, Grantown, Forres, Nairn and Inverness, due 3.55 p.m. This caters for traffic of the "Winter Sports" character; as the districts served offer facilities very similar to those available in Switzerland and other countries for ski-ing and other sports, and as foreign transit is largely cut off under war conditions, there is good reason to expect that this development in Highland facilities will justify itself.

(To be continued).

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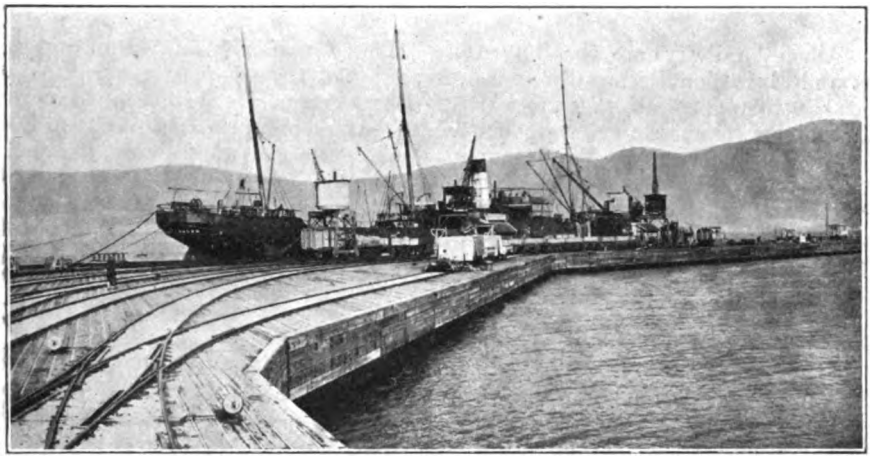

DEEP WATER PIER AT SMYRNA: OTTOMAN AIDĪN RAILWAY.

In close proximity are extensive warehouses. Since the photograph was taken the equipment has been nearly doubled.

The Railways of Asia Minor.

By G. WILLANS.

TURKEY'S entry into active co-operation with Germany in the present war was, to those who knew of the relations between the two countries, almost a foregone conclusion, and if even the excuse of the battleships that Turkey "bought" from Germany had not existed, there is little doubt that some other reason would have been discovered by Germany to persuade Turkey to enter into hostilities with the Allies. The railways of Asia Minor have therefore a special interest at this time, and it is proposed to consider in what way they affect the positions of the Allies and Germany, both now and as far as can be foreseen at the conclusion of hostilities.

The most important railway is naturally the Baghdad, or Anatolian, an essentially German railway of international influence. Nominally, arrangements were concluded comparatively recently to render this railway less German in constitution, by appointing a joint board with British representatives, but that this would be sufficient to counteract the enormous German influence is, to say the least, problematical. This railway has been frequently described in the Press, and is comparatively well known, though the changes in the ultimate terminus of the line, concessions as to various branches, and other factors make it difficult to even surmise what the present position is, and it is therefore sufficient to note that the route originally contemplated was from Constantinople to Bashrah on the Persian Gulf.

At Constantinople the terminus is on the Asiatic side, at Haida Pasha, and the line skirts the Sea of Marmora, thence proceeding inland to Eski-shehr, where there is a junction with a branch from Angora. Proceeding south-west, it makes another junction which, at the present time, is of great interest, at Afion-kara-hissa, where the line joins the Smyrna-Cassaba Railway, which is owned and worked by a French Syndicate, under a kilometric guarantee from the Turkish Government. From Afion-kara-hissa the line runs to Konia, a town of some importance in the interior, and the capital of the vilayet of Konia. This portion of the line is in operation, and the extension is proceeding or surveyed *viâ* Adana to Baghdad and Bashrah.

This project is a large one, though quite feasible were this trans-Continental line completed, and in German hands the effect on our position in India can, in the light of present events, be well imagined. However, by our successful attack and occupation of Bashrah and inland to Baghdad, this question would seem to be effectively decided in our favour, and in view of the position of the occupied territory, and its relation to the railway system of this area, there is no doubt that a strong feature will be made of this occupation when the final settlements are arrived at.

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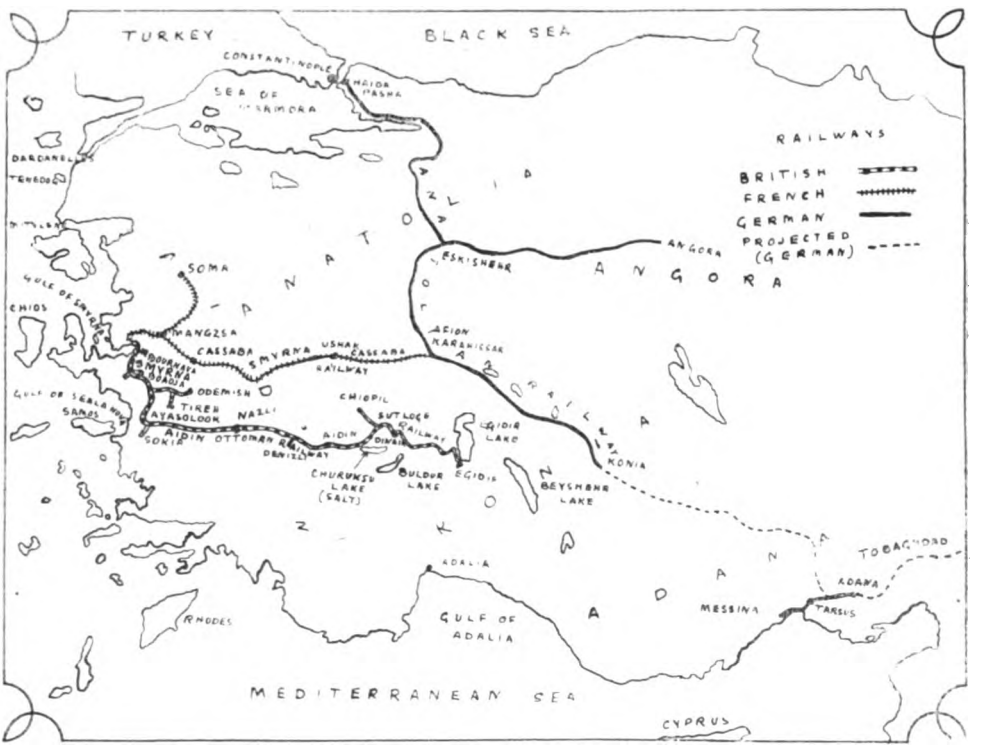
The "Allied" railways are the Smyrna-Cassaba and Extension Railway previously mentioned, a French owned railway, which operates under a kilometric guarantee from the Turkish Government, and the Ottoman (Smyrna-Aidin-Dinair-Eghidir) Railway, usually known as the Ottoman (Aidīn) Railway, a British owned and worked railway operated entirely as a business undertaking, having no Government guarantee.

It will be noticed that both these railways operate from Smyrna. The Smyrna-Cassaba line runs almost directly north out of Smyrna, then due east, *viâ* Cassaba and Ushak to Afion-kara-hissa, where a junction with the Baghdad line is effected. Until quite recent years there was no actual connection of the two systems, they being separated by just a few rail lengths which were laid down and taken up again as required when any special occasion made it necessary, such as the receipt of new rolling stock for the French line running on its own wheels, though this was more or less an unofficial arrangement. More recently, however, the two systems have been permanently linked up.

The Ottoman (Aidīn) Railway proceeds almost due south from Smyrna to a point near Ayasolook (a station in close proximity to the remains of the ancient city of Ephesus), and thence runs east almost parallel to the "Cassaba" line *viâ* Aidin, Dinair, to the terminus on the shores of Lake Eghidir. The extension from Dinair to Eghidir is of quite recent date, and when viewed in relation to the Baghdad line it can be well understood how it menaces the interests of the German policy.

It must be remembered that traffic interests over long distances are affected, for by means of camel transport, goods are brought from distances of upwards of 30-40 miles, so that when the possibilities of water-borne traffic on the lake are further taken into account it will be seen that the Ottoman (Aidīn) line will obtain a considerable amount of traffic which would otherwise be carried on the Baghdad railway. The proposed Adalia branch of the latter will also, in all probability, be subject to this influence, so that the British-owned railway has a significant interest at the present time. Naturally traffic tends to go to the nearest seaport,



SKETCH MAP SHOWING THE RAILWAYS OF ASIA MINOR.

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and as Smyrna is the "Liverpool" of the Eastern Mediterranean, this is another inducement to divert traffic from the Baghdad line to the French and British lines.

There is practically no interchange of traffic as between the French and British-owned lines, though this has been proposed on several occasions. The two lines cross one another almost at right angles just outside the city of Smyrna, and there is now a loop connection for the interchange of military traffic, which no doubt the authorities will avail themselves of as may be necessary. The Ottoman (Aidīn) Company has the advantage in respect of the shipping facilities at the Smyrna terminus, where fine warehouses are provided in direct communication with a deep water pier capable of accommodating ships of the maximum tonnage calling at the port. This and the extension of the line is part of the progressive policy that the British Company has carried out during recent years.

It may be noted that the railways have little strategical importance in the operations at present on the Caucassian frontier, or with regard to Egypt, the only enemy value from this point of view which they possess relating to the concentration of troops on Constantinople, as it is not likely that it would be attempted to ship them by sea from Smyrna, the risk of disaster from the Allied Fleets being too great. Should, however, the "Allied" railways fall ultimately into German hands (there does not appear to be any reason for anticipating that this will be the case) the value to German interests would be enormous; they would then be able to equip a rich and easily fortified base at the eastern end of the Mediterranean, a direct menace to Egypt and the Suez Canal.

On the other hand, if German and Turkish interests are finally settled in favour of the Allies, then the present railways will undoubtedly reap the advantage of their enterprise; the British line will be extended in several directions, say to Adalia, or linked up to the Baghdad line at Konia, there could be an interchange of traffic over all the lines, and the whole system amalgamated into one corporation

Asiatic Turkey offers great possibilities, a fact that the Germans have recognised; if this interest can be turned from them to the advantage of the Allied Powers it would do more to solve the Near-Eastern question than anything else. Indeed, if Turkey were under the administration of any of the European Powers (Germany excepted) it would prove the turning point in her history. The equipment of each railway is modelled on the practice of the countries to which they belong, and taken all round is of an up-to-date character, the French line being rather the exception, as this was originally a British enterprise, but fell into low water, and was bought up by the present French syndicate, so that the stock is composed of a mixture of the old company's equipment and the newer stock built on French designs.

Virtually, all these railways are single-track, laid with flat-bottom rails. Important towns and crossing places are provided with good station facilities, otherwise the provision usually consists of a station building, with a small warehouse and a siding. Water is plentiful; coal is usually imported from England, though a lignite coal is obtainable in the country but is useless for railway work. A better grade of coal from the Black Sea is also employed, but whilst being of undoubted value as a gas coal and for stationary purposes, this is not sufficiently good for locomotive purposes. The French Company also import briquettes for their locomotives in the same way as they use them in France. Traffics mainly consist of cereals, carpets, figs, liquorice root, also several minerals, the chief being emery, with some antimony and valuable ore. Speaking generally, however, the resources of the country are still undeveloped.

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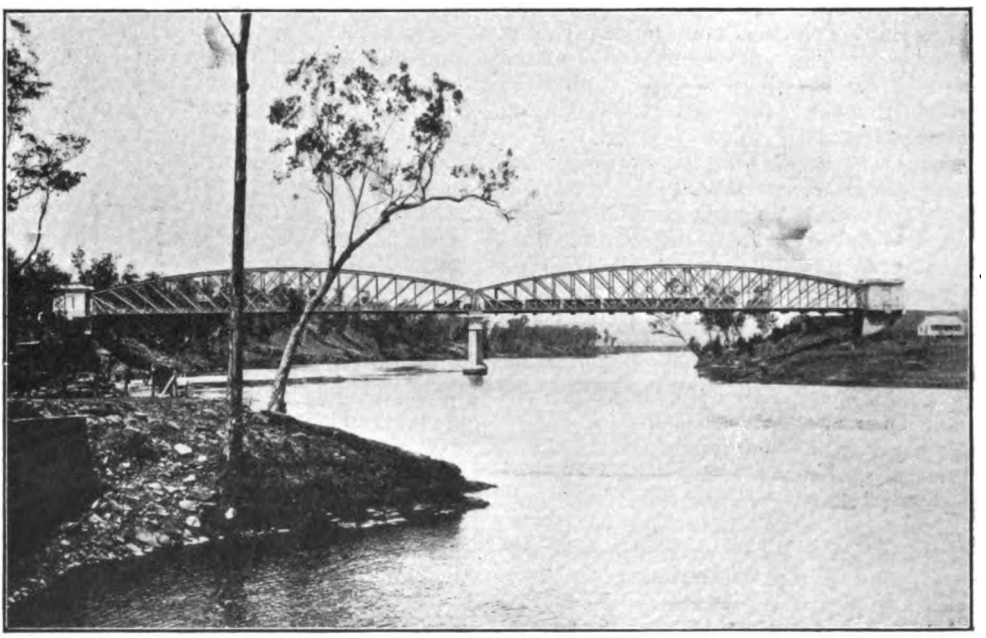
Queensland Government Railways.

AN ANTIPODEAN RAILWAY JUBILEE YEAR.

DURING the year ending June 30, 1914, the Queensland Government Railways celebrated the 50th anniversary of the turning of the first sod of a railway in the State, and the railway revenue was the largest yet earned, being £3,660,022, or £338,350 higher than that for the previous financial year. Working expenses, renewals, etc., came to £2,371,261, an increase of £220,270, and the net revenue (£1,288,761) was accordingly higher by £118,080. This represents £3 16s. 2d. per cent. upon the capital invested in open lines.

Net earnings per train-mile during the year were 2s. 3¼d., as against 2s. 0½d. in the previous twelve months, notwithstanding the increase in train-mileage arising from the opening of new lines. The percentage of working expenses to revenue was 64·79, compared with 64·76 the previous year. It is anticipated that some 211 miles of new line will be opened during the current year,



INDOOROOPILLY BRIDGE: QUEENSLAND GOVERNMENT RAILWAYS.

Some 189 miles of new railway were opened during the year, including 88 miles forming parts of the great coastal line from Gladstone to Cairns, which will ultimately give through railway communication between Adelaide and the north of Queensland. During the current year 98 additional miles of line have been opened, bringing the total mileage owned by the Queensland Government Railways up to 4,668 miles on the 3 ft. 6 in. gauge, including 45 miles of the coast railway and 37 miles on the Great Western Railway. Parliament has also authorised 1,423 miles of line, including 316 miles of coast line and 1,048 miles on the Great Western section.

Train miles run in year ending June 30, 1914, amounted to 11,346,334 as compared with 10,327,237 in the year ending June 30, 1912, and passenger journeys numbered 22,252,476 as compared with 17,080,756 in the twelve months that ended June 30, 1912. It will be observed that there is a marked difference in the two years.

Of vast importance to the railways is the pastoral industry, as is well demonstrated by

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the fact that revenue from live stock and wool during the past year amounted to no less than £642,693, as compared with £569,978 in the preceding twelve months. Government statistics show that on December 31, 1913, there were 21,786,000 sheep in the State and 5,322,033 cattle.

To the locomotive stock 22 new engines were, during the year, added to the stud, while two were condemned, leaving a net increase of 20. The new engines were all supplied locally, 10 being built in the railway shops at Ipswich. Of carriages 56 were built in the Ipswich workshops. The deliveries of goods wagons were again heavy, the total reaching 831, of which 562 were built in the Ipswich workshops, and 268 by contractors. The rolling stock figures for the past three years are as follows :—

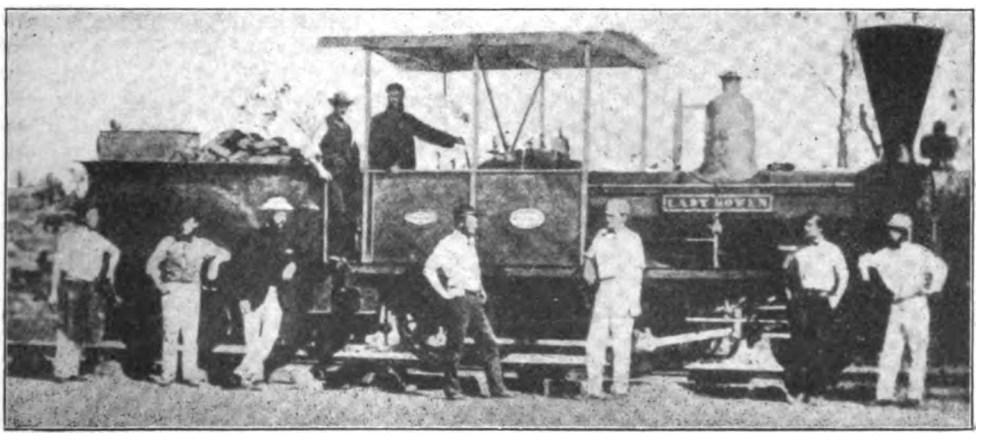
Year to June 30.	1912.	1913.	1914.
Engines	355	588	608
Carriages ..	610	642	703
Suburban ..	69	96	125
Lavatory ..	257	273	315
Others	284	273	263
Goods wagons ..	8,481	9,243	9,796
Coal wagons ..	2,322	2,393	2,623
Brake vans ..	169	170	171

During the year 1,757 appointments were made and 935 men left the service, the net increase being 822. On June 30 there were 11,254 employés on the staff, and in addition some 3,000 men were engaged in the construction of new lines and other permanent works.

From an operating point of view, the Queensland Government Railways have special difficulties. There are three principal lines running west and south-west from the coast ; the Great Western, from Brisbane on the south to Cunnamulla, 2,184 miles, with a branch to Cheepie ; from Rockhampton in the centre to Longreach ; and from Townsville in the north to Winton and Cloncurry. Five other lines open up the interior from the ports of Bowen, Cooktown, Cairns, Mackay and Normanton. The eastern termini of the southern and central sections are now connected by the coast line, but the central and northern sections are still separated from each other. This will be remedied on the east by the completion of the coast line, whilst the western termini will eventually be linked up by a great line authorised by Parliament, which will also serve the north-west of the State.

Meanwhile disadvantage is experienced in providing stores and material for the isolated systems. Although the value of such stores now on hand is by no means excessive, the necessity for keeping a firm grip on the transactions of this important branch of the service is realised. Accordingly the Commissioner, Mr. Charles Evans, prior to leaving (for about six or seven months) on April 12 last for Great Britain, the European Continent and America, arranged for an officer to be appointed and attached to the Secretary's staff, whose duty it is to travel throughout the State and inspect stocks of stores and material at various depôts, with a view to reducing surplus stores, disposing of obsolete stocks and inquiring into the method of working generally ; further, to assist in organising a system under which those matters will, for the future, be controlled more directly by the Commissioner.

At the commencement of the year H.M. King George was pleased to confer upon the Commissioner the honour of the



THE FIRST LOCOMOTIVE EMPLOYED ON THE QUEENSLAND GOVERNMENT RAILWAYS.

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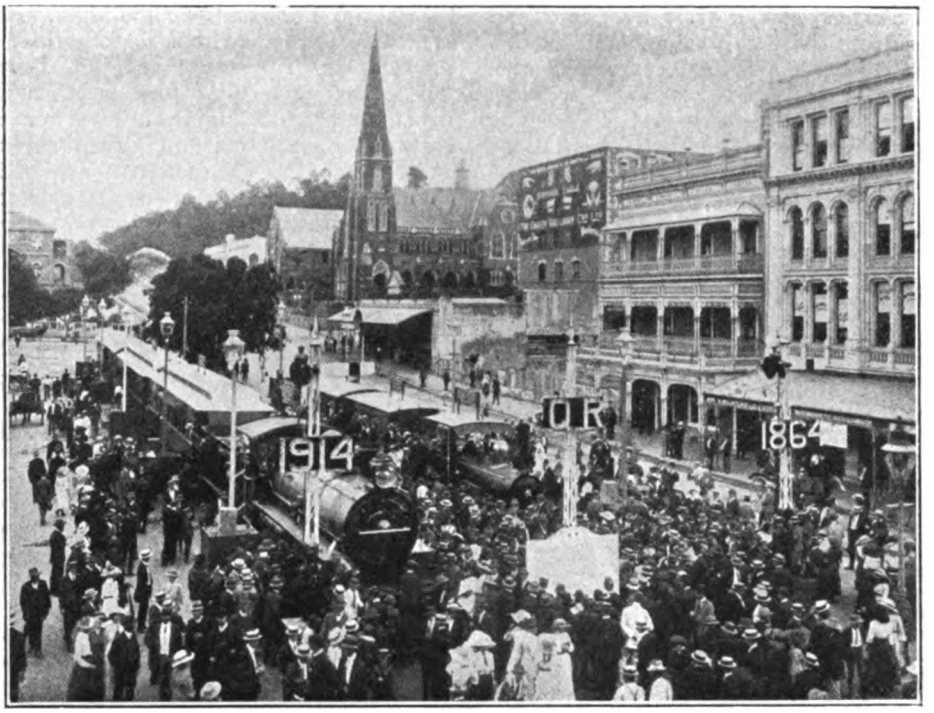

RAILWAY JUBILEE DISPLAY: MARKET SQUARE, BRISBANE.

Companionship of the Order of St. Michael and St. George. Mr. Evans was the first Queensland Commissioner for Railways to receive a decoration.

Extensive additions to station accommodation necessitated by the rapid extension of traffic, coupled with the large amount of railway construction in hand and authorised, have made it desirable to divide the control of the civil engineering branch. The vacancy caused by the appointment of the late Chief Engineer (Mr. N. G. Bell) to a position under the Commonwealth Government was, therefore, not filled, the duties being sub-divided by the appointment of an Engineer in Charge of Construction, who controls the building of new railways and large works on existing lines, and by the appointment of two Engineers in Charge of Maintenance—one controlling the Southern and Central Division and the other the Northern Division. In further pursuance of the policy of decentralisation, the work in connection with signalling, interlocking, lighting, etc., has been placed under one officer—the Signal and Light Engineer.

To celebrate the 50th anniversary of the turning of the first sod of the Queensland Railways, an interesting exhibition of some of the newest and some of the oldest types of locomotive engines and passenger carriages was made in the Market Square, Brisbane, and a photograph of the function is reproduced on this page.

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Locomotive and Train Working in the latter part of the 19th Century.

LONDON AND NORTH-WESTERN RAILWAY. [No. 1.]

By E. L. AHRONS, M.I.Mech.E, M.Inst.Loco.Eng.

IF readers can imagine themselves translated back to the year 1876, and to take a journey from Euston to Crewe, they would see eight main types of passenger tender engines, of which several types would have to be subdivided into two or three different classes. Of the above engines, distributed over the whole of the line, about 190 were "singles," 236 four-coupled, and about 100 four-coupled 5 ft. "Crewe goods," which were then almost invariably used for passenger trains. Of all these—more than 500—engines, only 18 now remain at work, 17 of which belong to the first batch of 20 "Precedents" built in 1874-5, the only ones of the class then running. The other engine is the celebrated 8 ft. 6 in. single *Cornwall*. The change has been radical and complete, and the only link with the period referred to, with the exception of the 18 engines mentioned, is the abstract one of the colours of the rolling stock, for both engines and coaches carry the same colours to-day as they did then. The present style of painting the engines dates from about 1873, prior to when they were painted a medium green, but the Southern Division engines in McConnell's days had been brick red in colour. The coat of arms on the driving splashers of the passenger engines was first adopted by Mr. Webb in 1877 for his second batch (857 lot) of "Precedents."

The following types of engines were in use in 1876 :—

"SINGLE" DRIVING WHEELS, 2-2-2.

	Type and Class of Engine	Dia. of Driving Wheels.	Cylinders.	Boiler Pressure.	No. of Engines.
		ft. ins.	ins. ins.	lbs.	
A.	(1) Extra "Large Bloomers"	7 6	18 × 24 (inside)	120	3
	(2) "Large Bloomers"	7 0	16 × 22 ,,	120	40
	(3) "Small Bloomers"	6 6	16 × 22 ,,	120	29
B.	(1) Trevithick's *Cornwall*	8 6	17½ × 24 (outside)	120	1
	(2) ,, 7 ft. singles	7 0	15½ × 20 ,,	120	17
	(3) ,, 6 ft. ,, ...	6 0	15 × 20 ,,	120	39
	including L. and C. engines		some 16 in. × 20 in.		
C.	"Lady of the Lake" class	7 7½	16 × 24 (outside)	120	60

FOUR WHEELS COUPLED, 2-4-0.

D.	Ramsbottom's "Newton" or 1480 Class ..	6 7½	17 × 24 (inside)	120	96
E.	Webb's 2145 "Precursor" Class	5 6	17 × 24 ,,	140	20
F.	Webb's 2175 "Precedent" Class	6 7½	17 × 24 ,,	140	20
G.	6 ft. Coupled Passenger Engines	6 0	16 × 20 ,,	120	80
H.	5 ft. "Crewe goods"	5 0	15 × 20 (outside)	120	100 about

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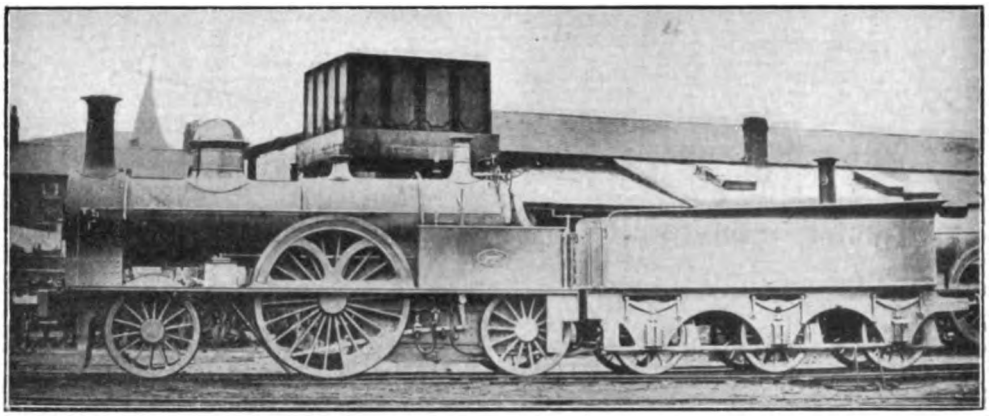

NO. 373 (SOUTHERN DIVISION), 7 FT. 6 IN. "EXTRA LARGE BLOOMER."
Built at Wolverton in 1861. Afterwards No. 1199, *Caithness*.

Dealing with the various types, but for the moment confining myself to those which worked principally between London and Crewe, the "Bloomers" were much the most numerous and, with reference to their express mileage, the most important.

The "extra large Bloomers" were the original 372, 373 and 375 of the Southern Division, and the largest "singles" on the London and North Western Railway. One of them, No. 373, had been shown at the 1862 Exhibition. One of these engines is shown in its original condition, but just prior to the period with which I am dealing, they had been reboilered at Crewe, so as to be very similar to the "large Bloomers" illustrated on page 19, except that the wheels were larger and the boilers stood higher from the rails. They then bore the following names and numbers:

1198 *Delamere*
1199 *Caithness*
1200 *Maberley*

and were stationed at Camden (1) shed. They did an undue share of piloting and odd work, and were not so frequently seen on the main line expresses as the 7 ft. class. Rumour used to have it that Crewe was always jealous of their performances, and made them "take a back seat." One of their runs will be given later in comparison with a "Precedent" on the up Scotch express, and on this occasion the "Bloomer" completely put the "Precedent" into the shade. They were built at Wolverton in 1861. I was frequently at Euston in 1878 and saw them daily—but generally on secondary expresses, and piloting.

The 7 ft. or "large Bloomers" did by far the largest share of the express work between London and Rugby. Of these, 847 to 856 had been constructed by Sharp Stewart & Co. in 1851 and 887 to 896 by the same firm in 1852. Their original appearance was as first illustrated (except that the names had been added as late as 1872, prior to when they ran without names). Nos. 989 to 998 were built at Wolverton on 1862, 999 to 1003 by Sharp, Stewart & Co. in 1861, and 1004 to 1008 by Kitson & Co., of Leeds, in 1861.

At the beginning of 1877 only a few had their original boilers, *viz.*:—890 *Helvellyn*, 1006 *Proserpine*, and 1007 *President*. These, together with 853 *Vulture*, 856 *Ingestre*, 892 *Polyphemus* and 896 *Daedalus*, the latter having been Euston pilot for some time, were broken up the same year. The 33 remaining engines had been rebuilt as shown on page 20, and were as follows:—

847	*Odin* ..	8	991	*Japan* ..	1
848	*Hecate* ..	8	992	*Stork* ..	—
849	*Aeolus* ..	8	993	*Burmah* ..	—
850	*Columbine*	8	994	*Ariel* ..	—
851	*Apollo* ..	8	995	*Briarlus*	6
852	*Basilisk* ..	—	996	*Raglan* ..	13
854	*Dalemain*	8	997	*Baronet*	1
855	*Sandon* ..	8	998	*Una* ..	13
887	*Knowsley*	8	999	*Medusa* ..	13
888	*Hydra* ..	8	1000	*Umpire*	13
889	*Camilla* ..	8	1001	*Leviathan*	1
891	*Duke* ..	—	1002	*Theseus* ..	13
893	*Harpy* ..	8	1003	*Tamerlane*	1
894	*Trentham*	—	1004	*Lucifer* ..	1
895	*Torch* ..	8	1005	*Achilles* ..	1
989	*Archimedes*	8	1008	*Rowland Hill*	1
990	*Alaric* ..	6			

Those marked 1 were at Camden (London), 6* Northampton, 8 Rugby, 13 Wolver-

* No. 6 subsequently became No. 5, taking the place of the Wolverton shed which had that number.

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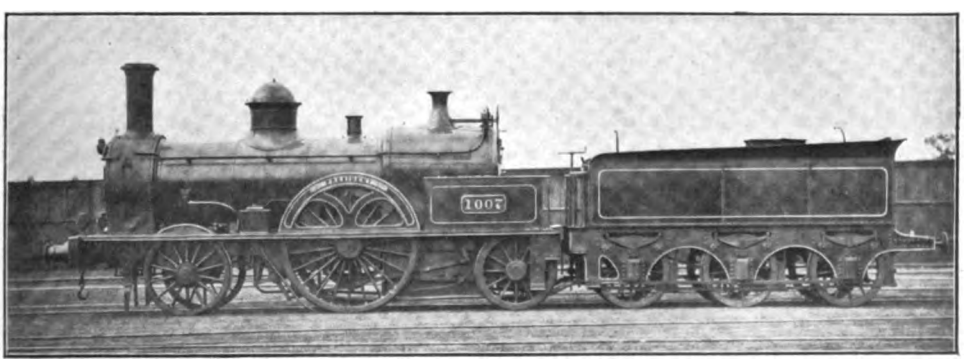
hampton. There were one or two at Bletchley, and in 1878 Nos. 991, 992, 994, 998 and 1001 were transferred to Crewe to relieve the "Precedents," which had gone into the shops for repairs.

The London "Bloomers" worked generally as far as Rugby, but I believe they had one turn as far north as Stafford. At least twelve main line expresses, some of them fairly heavy for those days, left Euston in charge of the 7 ft. "Bloomers." The Rugby men were in two links, of which the No. 1 or express link worked 5 expresses up to Euston, returning thence with the 3.10, 5, 6.50, 8.50 ("Scotch Limited Mail") and 9.15 p.m. trains. They also ran the 10.10 a.m. Manchester and Liverpool express from Rugby to Crewe, and the Newspaper Express from Rugby to Stafford. The Wolverhampton men ran the two fastest Birmingham expresses to Euston, and returned with the 3 p.m. and 6 p.m. trains and also had one double trip to Rugby and back.

The "Scotch Limited Mail" left Euston at 8.40 p.m. until April. 1877, when it was altered to 8.50 p.m. and accelerated. The load was usually 12 and sometimes 13 coaches, and the booked timing was:—Euston, dep. 8.50; Rugby, arr. 10.40, dep. 10.44; Tamworth, arr. 11.20, dep. 11.24; Stafford, arr. 11.55, dep. 11.59; Crewe, arr. 12.32. The "Bloomers" clung to this train for some years; when the change took place I do not remember, but in 1881 a "Precedent" was running it.

The 10 a.m. Scotch express was usually worked by a "Precedent" to Crewe, but when through some unforeseen cause one of the latter was not available, a "Bloomer" was always requisitioned. 998 *Una* kept time to Rugby with 15 coaches on this train, then allowed 103 minutes from Willesden to Rugby (old station), 77¼ miles. In connection with this substitution of "Bloomers" for "Precedents," during 1878 the curious phenomenon occurred of nearly all the "Precedents" having to be repaired at the same time, and there was a rush for the "Bloomers" to take their places. Even Crewe had to borrow five of them. 1008 *Rowland Hill* ran a train of 16 coaches and 2 trucks from Rugby to Bletchley, 36 miles, in 46 minutes. A good run for those days was made by 889 *Camilla* on the old 2.45 p.m. from Euston—Willesden, dep. 2.56½; Tring, pass 3.29; Bletchley, arr. 3.45. The 41¼ miles took 49½ minutes, a running average of 50 miles per hour, with a load of 8 coaches. The late Mr. Rous-Marten recorded a very excellent performance by 989 *Archimedes* on the up Birmingham express, then (1884) the fastest London and North Western train. The load was 7 six-wheeled coaches, and the times were:—Rugby to Bletchley, 36 miles, in 40 min. (54 miles per hour) and Bletchley to Willesden, 41¼ miles, in 46 min. 5 sec. (53·8 miles per hour). The maximum speed attained was 72 miles per hour. My last experience of the "Bloomers" was at the end of 1884 with 989 and 895 on a special train of 20 six-wheeled coaches, when we ran from Rugby to Bletchley, 36 miles, in 43½ minutes, an average of about 49·6 miles per hour. They never worked north of Crewe, except on casual occasions, though 997 *Baronet* once had to work the 4 p.m. express through from London to Manchester *viâ* the Potteries on the occasion of a breakdown to the Manchester engine. On this occasion 997 did well. Leaving Willesden at 4.16¼, she passed Tring 4.51¾, Bletchley 5.7½ and ran into Rugby (77¼ miles) at 5.50, an average of 49·4 miles per hour. The load was not noted,



7 FT. "LARGE BLOOMER," AS RUNNING IN 1876.

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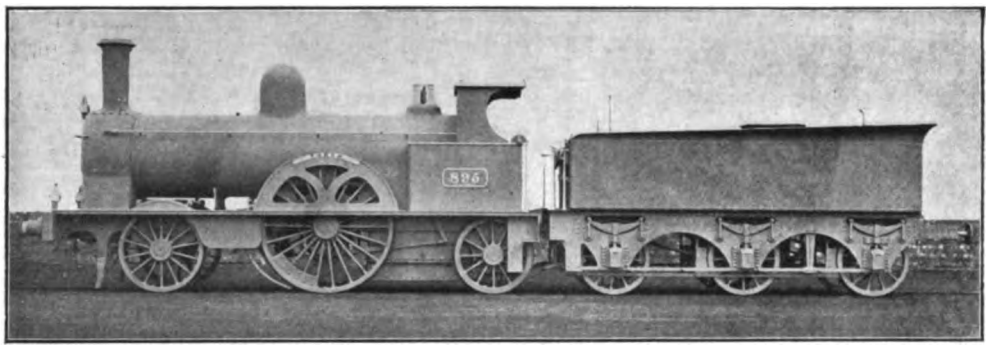

7 FT. "LARGE BLOOMER," REBUILT AT CREWE, AS RUNNING 1879-1884.

but would be about 8 or 9 six-wheeled coaches.

A small point in reference to these engines may be mentioned; the illustration shows 895 with a cab. The cabs were added in 1878–9 to those still at work, but when I saw the engines first, none of them had cabs, but only the very small Ramsbottom type of weatherboards.

Of the 847–856 batch the last two (850 and 851) survived until 1881 only, but the remaining 887 and 989 lots were put on to the duplicate list in 1882–5, and then rapidly disappeared. Their last journeys were generally between Rugby and Bletchley, and Rugby and Birmingham. The last two, 895 *Torch* and 992 *Stork*, were eventually numbered above 3000 and lasted until about 1889 or 1890.

I now come to the 6 ft. 6 in. or "Small Bloomers," as they were always termed. Relatively they were more powerful than the 7 ft. "Bloomers" in having a tractive force of 72·2 lbs. per lb. effective cylinder pressure, as against 67·05 lbs. for the 7 ft. class. But strange to say, during the period with which I am dealing they were never seen on any of the best expresses, but were relegated to slow main line and branch trains.

After they were rebuilt they became simply a smaller edition No. 895, except that they had weatherboards and not cabs.

I possess no particulars of any runs made by them Between 1877 and 1880, 614, 780, 789 and 838 were generally to be seen on the slow trains from Euston to Bletchley. 615, 717 and 978 were at Nuneaton, generally on the Leicester branch, and occasionally worked the Ashby and Nuneaton line. A considerable number worked between Rugby and Birmingham on the slow trains, and 740, 765, 768 and 629 were to be found on this service until 1883–4. One engine, 621 *Bela*, was quartered at Stafford, and ran slow trains on the Trent Valley. In 1881, 838 *Petrel* and 981 *Councillor* were regularly on the Birmingham and Derby service *viâ* Lichfield, and were stationed at Derby. Some ran on the Peterborough branch and others Bletchley to Oxford and to Cambridge. But they all disappeared between 1880 and 1885.

The probable reason that the "small Bloomers" did not run the main line expresses was their lack of adhesive weight. In their original form they had only 10 tons on the driving wheels as against nearly 12 tons for the 7 ft. type. The steam pressure in their later days was only 120 lbs. for both classes, but originally, in McConnell's time, they carried 150 lbs. pressure.

LIST OF "SMALL BLOOMERS."

602	*Caliban*	1858	
603	*Langdale*	1859	
607	*Inglewood* ..	1857	
614	*Wyre*	1854	V.
615	*Lune*	1854	V.
617	*Partridge*	1854	V.
621	*Bela*	1857	
623	*Medea*	1854	H.
625	*Mastodon* ..	1854	H.
626	*Earl*	1854	H.
627	*Bulldog*	1854	H.
629	*Swan*	1854	H.
630	*Ribble*	1854	H.
666	*Pheasant*	1859	
703	*Osprey*	1857	
717	*Swift*	1859	
740	*St. David* ..	1857	
765	*Herald*	1858	
768	*Glyn*	1858	
780	*Bucephalus* ..	1858	
789	*Cadmus*	1859	
838	*Petrel*	1857	
840	*Lonsdale*	1857	
917	*Napier*	1860	
977	*Sultan*	1861	
978	*Mammoth* ..	1861	

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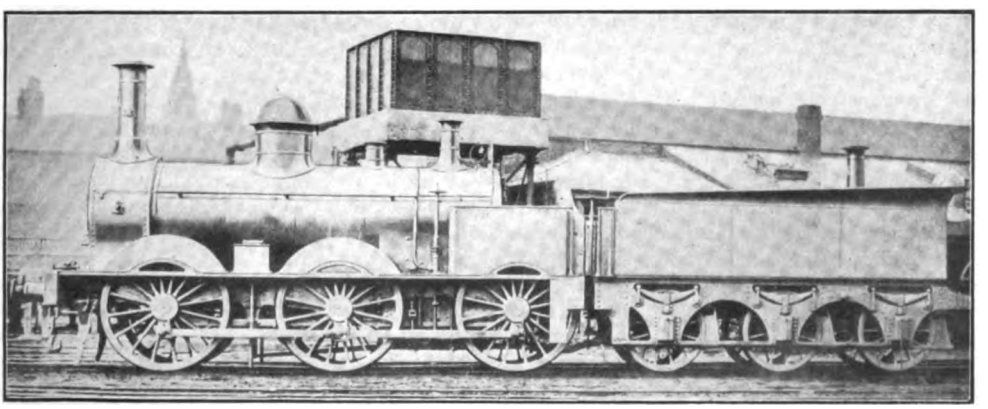
979 *Wasp* 1861
980 *Vandal* 1861
981 *Councillor* .. 1861
V.—Built by Vulcan Foundry.
H.—Built by R. & W. Hawthorn.

Two engines had previously been scrapped. It would be interesting to imagine ourselves spending 24 hours at Euston 37 or 38 years ago. In addition to the trains mentioned previously, which were worked by the Rugby "Bloomers," we should see the 11 a.m. to Carlisle, 12 noon to Liverpool, 5.10 p.m. Holyhead, and the midnight express all headed by the Camden "Bloomers." But we should, in addition, also see two other types of "singles." The Watford and St. Albans trains were worked by the 6 ft. "Trevithicks," 148 *Penguin*, 150 *Linnet*, 311 *Ida*, 324 *Messenger*, 353 *St. Armand*, 365 *Vesta* and 928 *Prince Eugene*, which were then stabled in London for this service. I do not intend to do more than mention them at this moment, as the "Trevithicks" were essentially "Northern Division" engines, not only in name but usually in fact, and will be described later. Moreover, they left Camden in 1878.

The same applies to the much more important main line express engines, the "Lady of the Lakes." These also were "Northern Division" engines, but worked several expresses to London. Stafford engines of this class had charge of the Irish Mail at 8.25 p.m., which they worked through to Stafford. The Stafford engine, which arrived with the up night Irish Mail, worked down from Euston with the 9.15 a.m. to Rugby. The engines usually on these trains were 7 *Scorpion*, 44 *Harlequin*, 97 *Atalanta*, 111 *Russell*, 222 *Lily*, and 234 *Mazeppa*. The 10.10 a.m. Manchester and Liverpool express was worked by a "Lady of the Lake," which belonged, I believe, to Crewe, but in 1878 a "Precedent" took charge of this train. Two famous trains were always worked by a "Lady" from Manchester, *viz.*:—the 7.45 a.m. from Manchester *vid* the Potteries, due at Euston 12.30 p.m., and the 4 p.m. down due Manchester 8.45 p.m. This was the train with which the *Charles Dickens* subsequently immortalised itself, but long before the *Charles Dickens* had emerged from Crewe works, the Manchester engines and men were working through to London. They worked in pairs, one engine of which came up on Mondays, Wednesdays and Fridays, and the other on the remaining three days. In 1876 667 *Marmion* and 127 *Peel* ran the trains; in 1877 196 *Leander* replaced *Marmion*, and subsequently the pairs were 60 *Tantalus*, 612 *Princess Alice* and 565 *Napoleon*, 1434 *Eunomia*. The two last were on duty until early in 1882, when the *Charles Dickens* took their place. But more will be said of the "Lady of the Lake" class further on.

In 1878 one of the Birmingham expresses was worked by a 6 ft. 6 in. Ramsbottom four-coupled, a class also to be mentioned more fully later. The Birmingham engines were 1523 *Marlborough*, 1525 *Abercrombie*, 790 *Hardwicke*, and 403 *Isabella*. These ran regularly to Euston, as also did one or two of the same class from Rugby, such as 1667 *Corunna*. But here also this class belonged so essentially to the "Northern Division" that I must again defer description. The classes which I have marked E, G and H were rare



MR. MCCONNELL'S 5 FT. 6 IN. GOODS ENGINE NO. 371.
Built at Wolverton in 1861. Afterwards No 971.

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visitors to London. There remain the twenty "Precedents," to which were relegated the heaviest trains of the day.

The "Precedents" were totally different engines from the Ramsbottom 6 ft. 6 in. coupled, though they have frequently been confused with them. The only points in common at that time were the sizes of the cylinders (17 in. by 24 in.) and the diameters of the wheels, 6 ft. 7½ in. for the coupled wheels of both classes. There was no possibility of mistaking one class for the other until 1878–9, when Mr. Webb began to alter the splashers of the Ramsbottoms to a pattern identical with the "Precedents." Even afterwards, apart from the "motion," a careful observer could always distinguish the smaller boilers and longer chimneys of the Ramsbottoms. The "Precedents" had a heating surface of 1,083½ sq. ft., of which the firebox supplied 103½ sq. ft. The firebox and grate were much larger than in the Ramsbottoms, and the "Precedents" carried 140 lbs. pressure in place of the previous 120 lbs. Although small engines, weighing only 32¾ tons in comparison with those on some other lines, the "Precedents" were the largest and heaviest on the London and North Western Railway, and immediately took the places at Crewe of the "Lady of the Lake" class, and at London of some of the "Bloomers." The twenty engines were distributed as follows:—

2183–4, 2191–2 and 2194 ..	London.
2175, 2181–2, 2185–90, 2193 ..	Crewe.
2176 to 2180	Liverpool.

They started in the early part of 1875 and (except Nos. 2177, 2181 and 2188) are still at work.

The Liverpool engines ran as far south as Rugby, generally with the heavy combined trains which left Crewe with both Liverpool and Manchester coaches.

The London "Precedents" had 4 trains daily to Crewe and back, and each worked four of these trips per week. Similarly the Crewe engines ran through to London with 3 trains, and to Rugby with one or two others.

The whole of the up and down Scotch expresses were handed over to the "Precedents," except the 8.50 p.m. limited mail and the early morning up Scotchman, still retained by the "Bloomers" between Rugby and London, but both these trains were worked between Rugby and Crewe by "Precedents."

Early in 1877 the following six trains left Euston headed by "Precedents":—

5.15 a.m.	Newspaper Express ..	To Rugby.
7.15 a.m.	Irish Mail	To Crewe.
9. 0 a.m.	Express	To Rugby.
10. 0 a.m.	Scotch Express ..	To Crewe.
3. 0 p.m.	Liverpool Express ..	To Crewe.
9. 0 p.m.	Scotch fast	To Crewe.

On July 1st, 1876, the up day Scotch express was re-timed to run Nuneaton to Willesden, 91½ miles, without stopping, at that time the longest run on the London and North Western Railway, and two interesting timings of this train were made about a year later. In the first case the engine was the 7 ft. 6 in. "Bloomer," No. 1199 *Caithness* and in the other the "Precedent," No. 2194 *Cambrian*. The two timings are perhaps best compared by reducing the start to zero.

M.			1199 *Caithness.* H. M. S.	2194 *Cambrian.* H. M. S.
—	Nuneaton ..	dep.	0. 0. 0	0. 0. 0
3⅜	Bulkington ..	pass	0. 7. 0	0. 7. 0
5¾	Shilton ..	,,	0. 9.40	0.10. 0
9	Brinklow ..	,,	0.13.25	0.14. 0
14¼	Rugby ..	,,	0.19.10	0.21.15
21¼	Crick (now Welton)	,,	0.30. 0	0.32.35
27½	Weedon ..	,,	0.36. 5	0.39. 5
34¼	Blisworth ..	,,	0.43.45	0.47. 5
—	Roade ..	,,	0.47.25	0.51. 5
44⅝	Wolverton ..	,,	0.55.30	0.59.50
50⅜	Bletchley ..	,,	1. 2. 0	1. 6.15
56⅞	Leighton ..	,,	1. 9.45	1.14.30
61	Cheddington ..	,,	1.14.45	1.19.30
65⅜	Tring	,,	1.20.50	1.26.20
69⅛	Berkhampstead	,,	1.25.20	1.31. 0
72½	Boxmoor ..	,,	1.29.15	1.34.15
76	King's Langley	,,	1.33.10	1.38.30
79½	Watford ..	,,	1.37.20	1.42.10
81	Bushey ..	,,	1.39.10	1.43.40
83¾	Pinner	,,	1.42.25	1.47. 0
85¾	Harrow ..	,,	1.44.35	1.49. 0
89	Sudbury ..	,,	1.48.15	1.52.30
91½	Willesden ..	arr.	1.52. 0	1.56.15

The gentleman who recorded these timings resided at Tamworth and was a constant traveller by the trains. There is not the slightest doubt as to the correctness of the observations, which were made within a few weeks of one another, but unfortunately the loads were not recorded, but had one of the two trains been loaded more heavily than the normal number of coaches, I feel sure that mention would have been made of the fact.

The two engines were not dissimilar as regards power, for the tractive force of the "Precedent" was 87·25 lbs. and that of the 7 ft. 6 in. single 86·4 lbs. Why the "Precedent" was so long in getting a start and why it took 2 min. 5 sec. longer to pass Rugby than the "single" is difficult to say, but the strange feature is that the "Bloomer"

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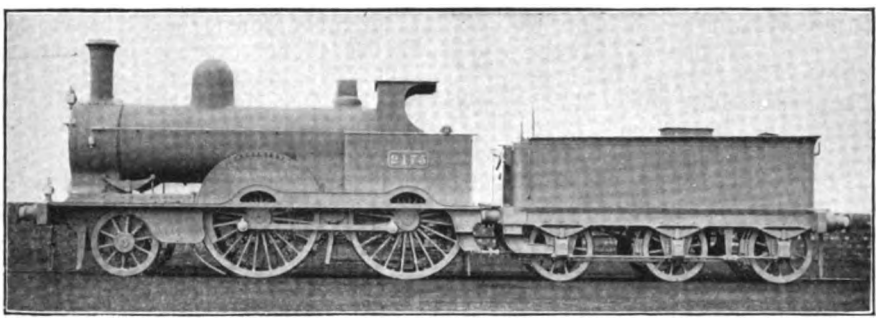
required only 42 min. 50 sec. between Rugby (pass) and Bletchley (pass), as compared with 45 min. for the "Precedent," and the section from Bletchley to Tring was covered by the "Bloomer" in 18 min. 50 sec., as against the "Precedent's" 20 min. 5 sec. —and uphill, too! It was only on the final downhill run from Tring that the "Precedent" woke up, and on this section to Willesden took 29 min. 55 sec., as compared with the "Bloomer's" 31 min. 10 sec. But there is not the least doubt that the "Bloomer" could have equalled the "Precedent" on the downhill piece, had it been necessary. The "Bloomer" averaged 49 miles per hour and the "Precedent" 47·2 miles per hour. What makes the runs more remarkable is that the "Bloomer" was only half a minute late out of Nuneaton, whereas the "Precedent" was 6¼ minutes late away, so that there was every incentive in the latter case to make up time.

2179	*Patience*	26
2180	*Perseverance*	26
2181	*Buffalo*	15
2182	*Giraffe*	15
2183	*Antelope*	1
2184	*Reynard*	1
2185	*Alma*	15
2186	*Lowther*	15
2187	*Penrith Beacon* ..	15
2188	*Chillington*	15
2189	*Avon*	15
2190	*Princess Beatrice* ..	15
2191	*Snowdon*	1
2192	*Caradoc*	15
2193	*Salopian*	1
2194	*Cambrian*	1

APRIL TO JUNE, 1877.

857	*Prince Leopold*	15
858	*Sir Salar Jung*	15
860	*Merrie Carlisle*	15
861	*Amazon*	8
862	*Balmoral*	8
863	*Meteor*	8
864	*Pilot*	8
865	*Envoy*	8
866	*Courier*	8



MR. F. W. WEBB'S 6 FT. 6 IN. 2-4-0 ENGINE NO. 2175 *Precedent*, BUILT 1874.

What lends special interest to the runs is that No. 1199 *Caithness* was the identical 373 of the 1862 Exhibition, except for a new boiler. I do not mean to imply that one isolated case such as the above proves that these three 7 ft. 6 in. singles were invariably better than the "Precedents," but it throws something of a side light upon the way in which the Crewe authorities of that day always relegated these three fine 7 ft. 6 in. singles to secondary trains and odd piloting jobs. The old drivers used to say that Crewe was afraid of them, and never would give them a chance.

In 1877 twenty more "Precedents" came out and were stationed as in the following list:—

SEVENTY ORIGINAL "PRECEDENTS," 1874–82.

DEC., 1874, TO MAY, 1875.

2175	*Precedent*	15
2176	*Robert Benson*	26
2177	*Edward Tootal*	26
2178	*Pluck*	26

867	*Disraeli*	8
868	*Condor*	8
869	*Llewellyn*	8
870	*Fairbairn*	1
871	*Proserpine*	1
872	*Wizard*	1
883	*Phantom*	6
890	*Sir Hardman Earle* ..	26
1105	*Hercules*	6
1177	*Princess Louise*	15
1189	*Stewart*	15

AUGUST AND SEPT., 1878.

193	*Rocket*	—
517	*Marathon*	1
749	*Mercury*	8
919	*Nasmyth*	—
1170	*General*	—
1173	*The Auditor*	—
1183	*Plynlimmon*	—
1187	*Chandos*	—
1193	*Joshua Radcliffe* ..	15
1194	*Miranda*	15

OCT. AND NOV., 1880.

619	*Mabel*	8
789	*Breadalbane*	—

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477	*Caractacus*	15
478	*Commodore*	15
480	*Duchess of Lancaster* ..	8
482	*Pegasus*	8
506	*Sir Alexander Cockburn*	8
512	*Lazonby*	8
514	*Lawrence*	—
945	*Humphrey Davy* ..	—

JAN. AND FEB., 1882.

253	*President Garfield* ..	26
254	*President Lincoln* ..	26
256	*President Washington* ..	26
257	*Duke of Albany* ..	15
260	*Duke of Connaught* ..	15
262	*Wheatstone*	15
264	*Buckland*	15
265	*Thomas Carlyle*	15
364	*Henry Pease*	16
955	*Charles Dickens* ..	16

Sheds.—1, Camden; 6, Northampton; 8, Rugby; 15, Crewe; 16, Longsight (Manchester); 26, Liverpool.

Rugby and Northampton for the first time had "Precedents" and a number of 7 ft. "Bloomers" were displaced, *e.g.*, from the 10.10 a.m.* and the 8.50 p.m. Limited Mail from Euston. But in 1881 London still had six of the 7 ft. "Bloomers" at work.

In 1881 the "Precedents" were taking 16 of the best trains daily out of Euston, and four trains (the 10.10 a.m., 12.45 p.m., 4.10 p.m. and 12 midnight) were still worked by 7 ft. "Bloomers." The Manchester "Lady of the Lake" class worked the 4 p.m. and the Stafford engines worked the up Irish Mail. The 4.10 p.m was, I believe, the fastest down train of the day, and averaged 51 miles per hour from Willesden to Northampton. In 1882 the "Bloomers" retired from it, and the "Precedents" replaced them. In 1882 the last of the "Lady of the Lake" class also retired. Their 12.30 in and 4 p.m. return became the exclusive property of *Charles Dickens*, and the first of the new compounds, 66 *Experiment*, replaced a "Lady of the Lake" on the up Irish Mail.

A few words as to the principal trains at this period. The fastest were the 4.10 p.m. down mentioned above, and a corresponding up Birmingham express, 7.30 a.m. from New Street, which ran Rugby to Willesden in 92 minutes (50·4 miles per hour). The 10 a.m. Scotch express was a somewhat leisurely express, which appeared to depend upon its reputation as an old-established concern. It required 103 minutes from Willesden to Rugby (average 45 miles per hour), but thence smartened up to Crewe, taking 96 min. for the 75¼ miles (average 47 miles per hour). The 8.50 p.m. Scotch Limited Mail ambled gently down the main line at 45 miles per hour between stops, and was considered a "great" train at that! The Manchesters were somewhat better and one ran from Rugby to Willesden at 49·3 miles per hour. This was one of the then 4½ hour trains. In 1883 the fastest run was made by the 9.30 a.m. up from Birmingham, which ran the 60¼ miles from Northampton to Willesden in 70 min. (51·6 miles per hour).

(To be continued.)

* Later the "Bloomers" appear to have resumed on the 10.10 a.m.

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Railway Operation in Alaska.

By EDWARD I. CLARKE.

IN writing these notes I would ask that they be accepted as reminiscences, rather than as a technical work, as they represent experiences the writer has had recently on the operating staff of the principal Alaskan Railway.

Generally speaking, the outer world seems to know very little about Alaska, its climate, its population, or indeed of any of its resources. Many people have recollections of the great Klondyke boom and visions of reindeer-drawn sleighs crossing vast wastes of ice and snow, and so come to the conclusions that Alaska is a kind of glacial annexe to the North Pole and highly undesirable as a residence. This is true not only of Europeans but also of many residents of the United States, and when I left the semi-tropical climate of California to take a hand in the working of an Alaskan railway many were the attempts to dissuade me from my "mad" venture, whilst the general tenour of letters from the "Old Country" was the expression of a hope that I would return to civilisation alive.

These sympathies have turned out quite unnecessary, however, as Alaska, or at any rate the southern and south-west portion, is a quite habitable—and inhabited—country and has a climate which, to use an Americanism, has the English climate "skinned." But this is digressing from railway topics.

Alaska has several railways. In the south there is the White Pass and Yukon, running inland from Skagway and up over the international boundary to White Horse in Canadian territory. This forms part of one of the summer routes to the interior, as during the open season on the Yukon River boats ply from White Horse right down to the mouth of the river at St. Michael's on the Behring Sea. The railway is only narrow gauge and 111·4 miles long. It passes through very pretty scenery, but as a railway there is really nothing very exceptional about it.

From Seward, on Prince William Sound, runs the Alaska Central Railway. This line was originally projected to run through to the Yukon River, but, like the late Manchester and Milford Railway, the project fell through for lack of funds and the ambitions of the promoters are not likely to be realised. There is about 70 miles of the railway constructed and a motor car maintains a rather spasmodic service, but the roadbed is falling into neglect.

Further north on the Seward Peninsula there are one or two smaller lines which operate during the summer months, and there is also the Tanana Valley Railroad, a little line connecting Fairbanks with the mining camps along the Tanana River.

The largest and most important Alaskan railway, however, is the Copper River and North Western. This is a standard gauge line running from the new port of Cordova, on Prince William Sound, to the copper mines at Kennecott, 196 miles inland. It forms part of the mail route to the interior, as the Orr Stage Company's route connects with the railway at Chitina, 131 miles from Cordova. The Copper River and North Western Railway is, I believe, the only one in the more northern latitudes which maintains a regular all-the-year-round service, as most of the lines are inoperative during part of the winter months.

On the line of the Copper River and North Western Railway the climate is very similar to that of England, although there are usually two or three varieties of weather sandwiched into the 196 miles of its length. On the coast, at Cordova, it never gets really cold. Indeed, during last winter the ruling temperature has been just above freezing. On the lower reaches of the Copper River, from Mile 26 to Mile 100, is the snow belt. Here it gets cold, although by no means Arctic, and the snow is usually heavy all through the winter. For the last 96 miles of the line the cold in winter is more intense, the temperature sometimes falling to 40° below zero, Fahr., but it is a dry crisp cold, without much wind, and the snowfall is very light, seldom more than three feet.

The north end of the railway does not present many operating difficulties. Snow is taken care of by a pilot plough attached to the engine, and the main trouble is where the line skirts the glaciers, as these "creep" across the track if they are not watched carefully.

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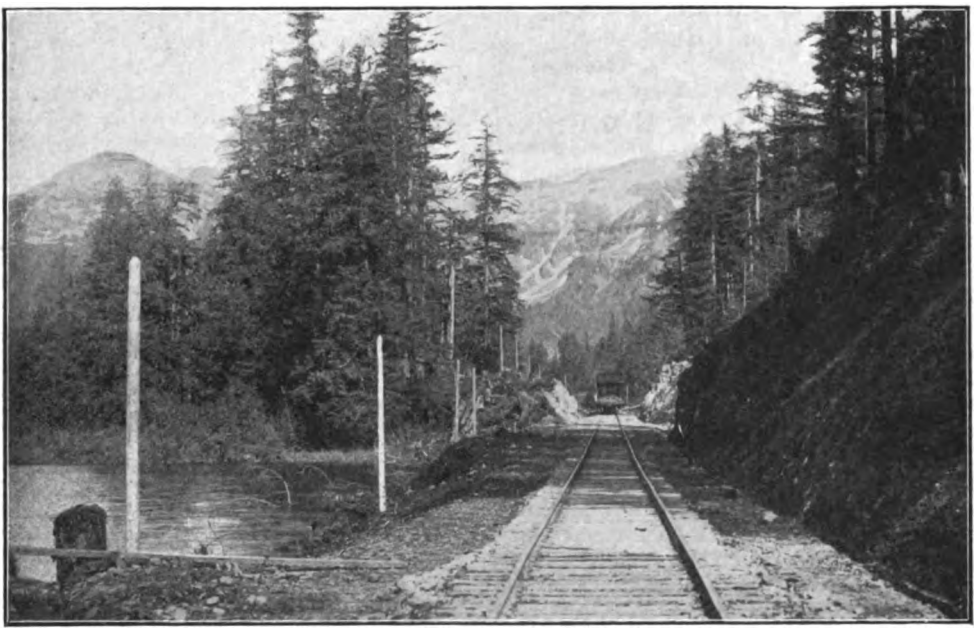
It is between Mile 26 and Mile 100, where the line crosses the flat sandy delta of the Copper River and then proceeds through the Abercrombie Canyon, that the winter troubles crop up. Across this stretch it is necessary to run a rotary snow plough ahead of every train to clear out drifts and slides. All along this territory bad gales are experienced, sometimes reaching a velocity of 90 miles an hour and over. These, combined with a heavy snowstorm, make railroading a somewhat difficult proposition, and no place for a weakling.

Miles Glacier, where the railway crosses the Copper River preparatory to entering the Abercrombie Canyon, is reputed to be the windiest place. A few months ago the night despatcher at Cordova was aroused early one morning by a prolonged ringing of the telephone. It proved to be the watchman at Miles Glacier, who announced in agitated accents that it was calm for the first time in six months. I do not think it has happened again since!

But of course there are graduated stages of breeze. During the construction days a wind gauge was erected at the Glacier. When the next blow came along the gauge hummed in a steadily rising key whilst the needle climbed the chart till it reached a velocity of 95 miles an hour; then the strain was too great and the next gust blew away the "wind catching" part of the apparatus. This reads like an "Americanism," I will admit, but I have seen the original chart myself. Often when speaking to some of the camps over the long distance telephone, somebody will open the door, and over the telephone can be heard the shriek of the wind round the building, like the twanging of a high key on a violin.

Usually it begins to snow in November and continues to do so. And even when the snow has finished falling from above it slides from the mountains. The rotary snow plough digs out a cutting for each train, but the wind drifts it full again in a short while and every now and then, as a break in the monotony, an avalanche will hurtle down the mountain, across the railway and into the river. There have not been any trains swept away by these avalanches, as the men are on the lookout for them and can usually see them coming in time to run ahead or back up out of their path. Having to dodge avalanches is perhaps a new feature of railroading. There was one instance last winter where a small slide hit the tail end of the rotary outfit and knocked in the cupola windows of the brake van, filling the interior with wet snow, to the intense disgust of the occupants. The train was running through a snow



Photo] [*E. A. Hegg.*

A BALLAST TRAIN NEAR TIEKEL.

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cutting almost car high, so this was all the damage the slide could do in its course to the river.

It is when the rotary snow ploughs break down that the real trouble begins, and the Superintendent must show his mettle if he is to keep the wheels turning. He must be resourceful too, as one is more or less isolated in Alaska and there are no foundries or industrial works within a five days' journey. At the end of December one of the rotaries broke a quarter shaft. Then two days later the second machine was derailed and overturned through the partial burning of a wooden bridge. This was a disaster, as trains could not be operated through the 75 miles of snow country without a rotary, neither could the breakdown train be got out to the scene of the accident. Fortunately only the rotary plough left the rails, and the engines and remainder of the train were able to back up to Chitina. Arrangements were made to repair the broken quarter shaft, but when it was discovered that the shaft was of eight inch diameter steel a temporary deadlock occurred. There was no steel of that dimension to be obtained in town, and a hasty canvas of the surrounding country brought no better result. So it was a case of improvise. The main shaft of a rock crusher was pulled out, but on test proved to be iron, and so was rejected. Then somebody noticed that the rollers of the boiler plate roll in the machine shop seemed about the right size, so one was quickly taken out, sent to the lathe and turned down into a quarter shaft and is still doing duty as such.

This of course took time. Meanwhile the railway was tied up for the 75 miles between Flag Point and Tiekel, although a shuttle service was run out of Cordova and Chitina as far as the train could get. But the company had a mail contract which said that the mail was to be conveyed three times a week, regardless of all else, and under penalty of heavy fines for failures. So the railway had to cast round for a means of transporting them. Road there was none. Rivers were covered with caked ice and snow, and it would take weeks to break a trail even. The only patch available was along the line, and owing to the open decked bridges and uneven ballast the only practical transportation was by sleighs drawn by teams of dogs or men. And so the mail was handled for over two weeks, without a single sack being lost, although on more than one occasion they were *cached* overnight or left tied to a telegraph pole when the blizzard got too severe to face. During this time emergency camps were opened up along the line to take care of the mail carriers or, to use the Alaskan term, "mushers," as it should be remembered on the 131 mile stretch between Cordova and Chitina there is no village or settlement, with the exception of the railway permanent way camps. The impromptu sleigh road started at Flag Point, and the first camp out was established at the water tank at Katalla Junction, 13 miles away, and a prospector who happened to be sheltering there was pressed into service as "cook-caretaker," although the cookery work was rather light for the first day or two, till a provision sleigh arrived, the camp subsisting mainly on coffee and canned beans, taken alternately. The first day was a novelty, but on the second the caretaker assured us over the 'phone that, cook them as you may, "beans straight" do get monotonous. This man was a quiet humorist and did much to enliven the dark period of the tie-up. Even when provisions became scarce, there was little grumbling, but just philosophical banter over the telephone. It was this man who, when asked by headquarters for a weather report, stood at the window and watched the weather for a few minutes and then replied that the air was full of snow, but whether it was new snow coming down or old snow blowing up he would not venture an opinion on.

The next temporary camp was at Miles Glacier, where the bridge watchman was appointed *chef*, and receiving a miscellaneous stock of provisions, had the time of his life experimenting therewith. He had no cookery book, but would get telephonic instruction in the art from other camps. The next stage was through the Abercrombie Canyon to the section camp of that name, and here the mails were transferred from men to dog teams for conveyance up the river for the remaining 45 miles to Tiekel.

During this time the weather fortunately kept fairly good. There were one or two blizzards which drove the "mushers" to shelter for a time, but not sufficient to handicap them. Superintendent Geiger, who runs all the departments of the railway, exchanged his private saloon for a sleigh drawn by a team of dogs.

The repairing of the rotary snow plough did not end the troubles by any means. It was promptly started out with a work train behind to clear up the line, but although the plough was pushed by two huge 2–8–0 goods engines it took seven days to accomplish the

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101 miles. It was just a test of endurance and patience. The snow had drifted and frozen and been packed down by the mail sleighs. The rotary would charge into a drift, to find that the wet snow had frozen over the rail, covering it with a think layer of ice. The bogies of the plough would mount this and slither sideways off the track. Then came the laborious task of picking the ice away and getting the machine on to the rails again. This occurred not once but many times. Indeed, derailments caused by ice on the track are common all through the winter. They are expected and no damage is done; it just causes a delay. Then the work train engine struck some ice and floundered off the track, and the rotary crew lost almost half a day getting her back on to the rails again. The engines ran out of water, and it was necessary to shovel snow into the tanks, and thaw it with a steam hose. One has to try it to appreciate how many shovels of snow thrown into the tank in a high wind are needed to make a gallon of water.

Next the rotary ran out of coal. The work train was robbed of what it had left and abandoned on a siding and the rotary pushed ahead. But soon all the fuel was exhausted again and it was necessary to prospect for wood to keep the fires going. Meanwhile, sleds of coal had been dispatched south from Tiekel to meet them, and finally, on the evening of the seventh day, the rotary reached Tiekel, with a crew tired but triumphant, having been on duty practically continuously for 145 hours; yet the English engine driver thinks he is hardly used if he has to work twelve.

This is the dark, or winter, side of things. In summer Alaska shows another side. Gone is the snow, except on the higher mountains, and the woods put on their spring mantle of green. Gone is the blizzard, and instead there are long days of sunshine. For six weeks the sun is visible for twenty-two out of the twenty-four hours. Then Alaska presents some of the most magnificent scenery in the world, and the choicest samples seem strewn along the path of the Copper River and North Western Railway. Childs Glacier, that glacial wonder of the world, is not five minutes' walk from Miles Glacier station, and forms the destination of innumerable excursion trains throughout the summer months. Here the ice-wall towers three hundred feet high along the river bank, in full view of the train as it crosses the Copper River, on a magnificent "iceberg proof" steel bridge, which is one of the heaviest structures in the world. It is 1,550 feet long and contains over nine and a half million pounds of structural steel. The largest span, across the channel where the icebergs float down, is 450 feet long and constructed on the cantilever principle.

Shortly after leaving Tiekel, the line enters Clay Wood Canyon, named after Brigadier-General Henry Clay Wood. Here the mountains rise almost sheer for thousands of feet

Photo] [E. A. Hegg.

IN THE COPPER RIVER CANYON.

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on either side of the narrow gorge. Below thunders the waters of the Copper River. The railway follows the river, now on a spidery trestle across a creek, now tunnelling through a rocky bluff, now on an embankment built along the river's edge. Seen on a fine day it is indescribably beautiful. Rounding some of the curves a glimpse may be obtained of Mount Wrangel, towering above her sister mountains, and often with a wreath of black smoke hanging over the crater. This is an active volcano, and its activity is often manifested by earthquake shock and tremors through the neighbourhood.

With the exception of the bridge at Miles Glacier, the only heavy bridge work on the railway is the cantilever structure across the Kuskulana Gorge, 250 feet above the river, and the three bridges crossing the main channels of the Copper River on the delta near Flag Point. There are substantial girder span structures, although not so heavy as the Miles Glacier Bridge. The gradients are easy. On the 131 miles from Cordova to Chitina the steepest gradient is 1 in 132, but between Chitina and the mines they are heavier, the last five miles up the hill to Kennecott being rather like the Lickey incline.

The railway possesses fifteen engines. There are six small 0–4–0 saddle tanks, four heavy 2–8–0 "Consolidations," used mainly for winter snow plough work, and three large and two small four-coupled mixed traffic engines, which are used to haul the local trains. The snow problem is handled by three rotary snow ploughs, one being a new arrival last year. There are six passenger coaches, of the standard American type, and some 250 assorted goods wagons. All the vehicles, both passenger and goods, are carried on two four-wheel bogies, and goods wagons are mostly 36 to 40 feet long, with a capacity ranging from 35 to 50 tons. Traffic is worked on the standard train order system, and I do not think there is a signal of any description on the railway, nor is there any need for them at present. There is a telephone line the entire length of the railway, with instruments in all the camps and stations, and in addition every brake van is equipped with a telephone, which can be cut in by simply hooking a "fishing-rod" over the wire, making it possible for the trainmen to communicate with the dispatcher at any time.

With the exception of the summer excursions, the trains are mixed, although a dining car is operated between Cordova and Chitina for the convenience of through passengers to and from the interior.

At present coal is the standard fuel on the railway, although the engines are now being equipped to burn crude oil or residium. This work is all being done in the Cordova shop and the engines so fitted are running satisfactorily.

In closing these disjointed notes, I would like to express a hope that any readers who are contemplating a trip to America, and those already in America who are looking for a holiday resort, to include in their itinerary a trip to Alaska. It is very easily accessible, although so little known, and a ten day trip from Seattle will take the traveller through some of the grandest scenery in the world.

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MR. WILLIAM CLACY MAY:
Chief Traffic Manager, Great Eastern Railway.

Last month we referred to the appointment of Mr. William Clacy May, hitherto Chief Goods Manager, to be Chief Traffic Manager of the Great Eastern Railway, with control of the passenger and goods departments. A new photograph of Mr. May is now given Mr. May was born in 1869, educated at Cranleigh School, and entered the service of the Great Eastern Railway in 1886, commencing his career in the Goods Manager's rates office, from which he was transferred in 1897 to the Mineral Department. He was appointed Mineral Manager in 1903 and Chief Goods Manager in 1910.

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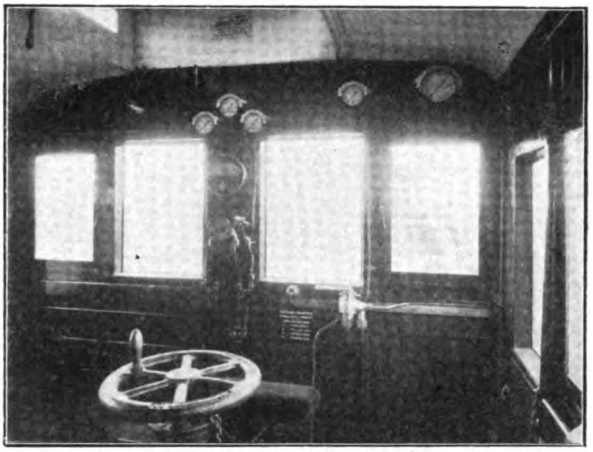
Motor Trains on the Great Eastern Railway.



DRIVING COMPARTMENT AT REAR OF TRAIN.

HITHERTO the Great Eastern Railway has been almost alone in respect of the non-use of rail motor cars or motor trains, although it has often been suggested that certain of its train services would afford good opportunity for their use. A motor train has now been placed in service between Cambridge and Mildenhall, and by the courtesy of Mr A. J. Hill, Locomotive Superintendent, is illustrated on this page and the next.

The engine employed is one of the smaller 2–4–2 tank engines of the 1300 class, introduced for branch traffic two or three years ago, with a boiler pressure of 160 lb. per sq. in., cylinders 15 in. diameter by 22 in. stroke, coupled wheels 4 ft. 10 in. diameter, and a total weight (loaded) of 45½ tons. Coupled to the engine is a 48 ft. 3 in. corridor composite carriage, seating nine first and thirty third-class passengers, the empty weight being 25½ tons. To this is attached a driving car, which is a 50-ft. third-class carriage, seating forty-six passengers, and weighing 26½ tons empty. The end compartment of this coach is set apart for the driver and guard. A gangway connection is provided between the two vehicles.

The train is operated by the driver, either from the engine footplate or from the compartment at the other end of the train, according to the direction of travel. In the driver's compartment are placed the necessary fittings to give him complete control of the train. These fittings consist of a driver's brake valve and air-pressure gauges for operating the Westinghouse brake, a cord connected to the whistle on the engine, an electric bell operated from the footplate, a bell push for communication by bell code with the fireman, and an air valve controlling the movements of the steam regulator on the engine. In connection with the last-named there are three gauges, and an electrically-operated indicator working in unison with the steam regulator on the boiler, and so denoting to the driver its exact position at any instant.

On the engine the steam regulator handle is furnished with a lever fixed at nearly right angles; and attached to this by means of a French pin is a connecting rod, the lower end of which is coupled to a lever fixed on a shaft placed below the footboard, which in turn is connected to the piston of the actuating cylinder. When the train is to travel engine first the connecting rod is disconnected and placed on a bracket fixed on the back plate of the firebox to the right of the regulator, thus leaving the steam regulator free to be moved by hand in the ordinary manner.

Compressed air for operating the steam regulator from the driver's compartment is taken from the main storage reservoir of the Westinghouse brake, the air passing through a reducing valve into an auxiliary reservoir at a pressure of 25 lb. per sq. in. lower than

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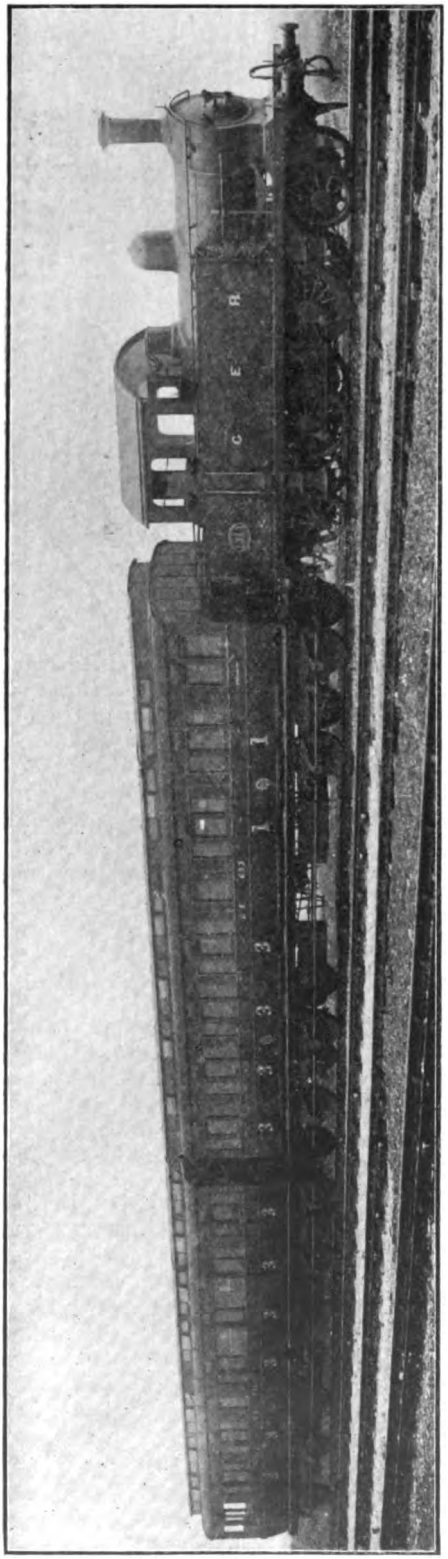

MOTOR TRAIN, GREAT EASTERN RAILWAY: CAMBRIDGE-MILDENHALL SERVICE.

the main pressure. This auxiliary reservoir is in direct communication with one end of the actuating cylinder, and by maintaining a constant pressure on one side of the piston tends to keep the steam regulator closed. The actual pressure in this reservoir is shown upon two gauges connected to the reservoir by a ¼-in. pipe, one of the gauges being placed in the engine cab and the other in the driver's compartment. From the main reservoir a 1-in. pipe with the usual Westinghouse cocks and flexible couplings is carried to the driver's brake valve. Off this pipe a branch is led to the air valve for working the steam regulator, a return pipe from which communicates through a quick release valve with the actuating cylinder on the engine.

When the driver's regulator valve is opened, air is admitted by the return pipe to the underside of the piston in the release valve, lifting this piston and passing into the cylinder to the side of the piston opposed to the back pressure. When the air pressure so admitted sufficiently exceeds the back pressure the piston is moved and the steam regulator is gradually opened. On placing the handle of the regulator valve in the neutral position, the pressure on each side of the piston is maintained in equilibrium, and the regulator remains stationary; by moving the handle to the exhaust position air is allowed to escape from the return pipe, the piston in the release valve immediately drops, air passes from the pressure side of the piston to the atmosphere direct, and the back pressure returns the piston to the end of the cylinder and closes the regulator. The quick release valve used is a Westinghouse triple valve with a slight modification of the ports.

The fireman has the care of all work required on the engine footplate, but the driver can by an electric bell and a series of code rings convey certain instructions to him, such as "Apply the brake" or "Shut the regulator." The latter operation can be performed by the fireman opening the emergency cock, which releases the air on the pressure side of the piston in the actuating cylinder, and thus enables him, if necessary, to remove the French pin from the end of the connecting rod and close the regulator by hand.

On the pipe leading to the back pressure gauge in the engine cab is a test and release cock, by which the back pressure can be reduced if at any time the main storage pressure falls too low to overcome it.

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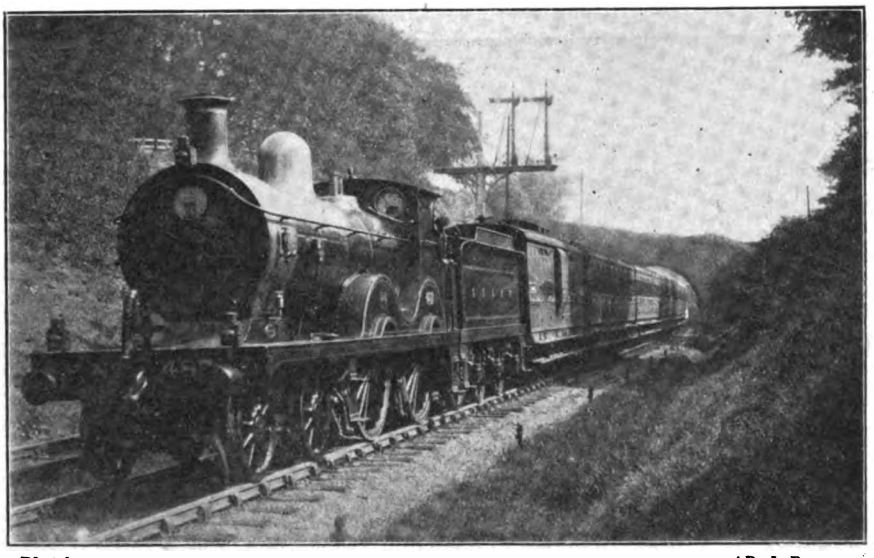

Photo] [*R. J Purves.*

SOUTH EASTERN AND CHATHAM RAILWAY.

10.25 a.m. through train from Deal to the London and North Western, Great Northern and Midland Railways, leaving Sandling Junction; 4–4–0 locomotive No. 487.

British Locomotive Practice and Performance.

By CECIL J. ALLEN.

IN accordance with precedent, the first article in the New Year must be one devoted to a review of locomotive practice and performance during the year just expired. Among the events of 1914, of course, the outbreak of war in August completely overshadows all others, however great may be their individual interest. With the causes and effects of the war it is not my province to deal here, save only in so far as it has affected British railways, and in the matter of the transport of troops these have, as is well known, played a noteworthy part. So secretly were these operations carried out that but few, other than those directly connected with them, can have had any adequate conception of their magnitude. To have arranged, at 60 hours' notice, some three hundred and fifty troop specials averaging thirty vehicles each, and to have worked practically the whole of these to Southampton with a minimum of interference to regular trains, was a feat unparalleled in the railway history of the country. Moreover, this herculean task was completed in 48 hours, or 20 per cent. less than the time allowed by the Government. A lion's share of the special working of necessity fell on the London and South Western Railway, seeing that Southampton was the principal port of embarkation, and it is on record that this company dealt with an average of 73 special trains to Southampton daily for three weeks, their working being confined to 14 hours out of each 24, which made the average interval between trains one of only 12 minutes. As we know, this necessitated a drastic curtailment of London and South Western train services during the period in question, at a time when the summer traffic should have been in full swing, but none of those affected could have grudged the loss of facilities in view of the incalculable value of the services rendered by the London and South Western Railway to the country at this critical time. On other lines the absence of any material interference with ordinary traffic has been nothing short of marvellous. All these things indicate a condition of locomotive and general working efficiency of which every railwayman in these islands may justly feel proud.

Notwithstanding the war conditions, 1914

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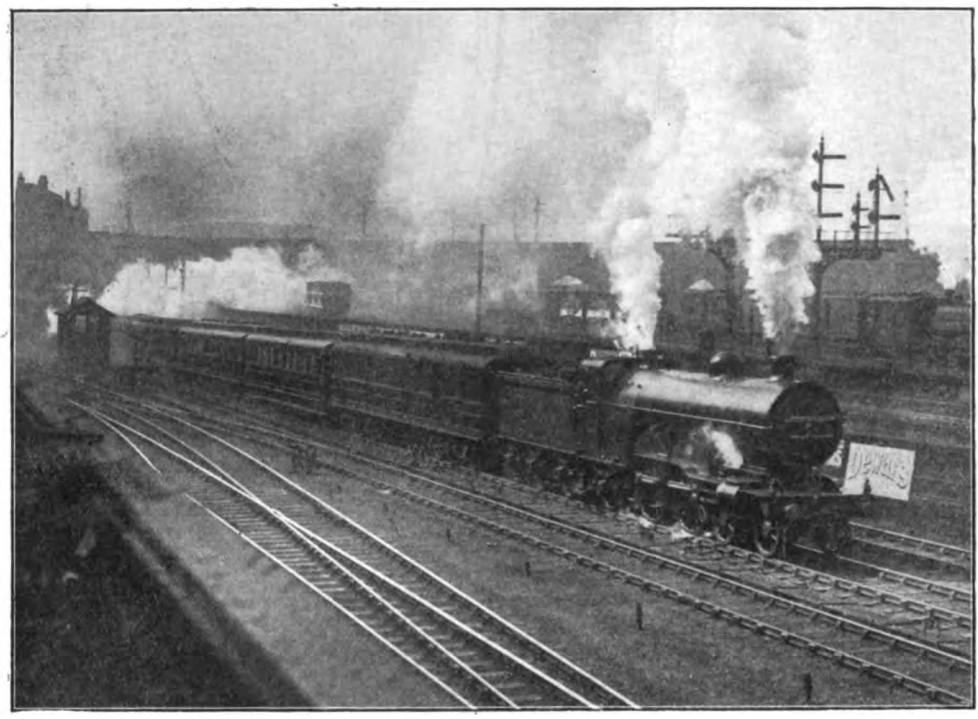

Photo] [*F. E. Mackay.*

GREAT NORTHERN RAILWAY.

10 a.m. Scotch express ascending bank out of King's Cross ; 4-4-2 locomotive No. 1441.

has been a year of substantial locomotive progress, and has seen the production of some noteworthy new designs. Among express locomotives the design that has excited the most comment has probably been that of Mr. Urie's 6 ft. 4–6–0 superheater locomotives on the London and South Western Railway. This marked the opening of a new era on the London and South Western Railway, as it is the first new type on the line in question for 15 years in which the Drummond cross-water tubes in the firebox have not been fitted ; it is also the first London and South Western type to be equipped with a high-degree superheater ; and the four-cylinder system of propulsion has been abandoned in favour of two large outside cylinders, 21 in. diameter by 28 in. stroke. Another new 4–6–0 express locomotive of no little interest—not running at the time of writing, but very shortly to issue from the shops—is Mr. Watson's four-cylinder design on the Great Southern and Western Railway of Ireland, which, conversely, represents the first use of a multi-cylinder arrangement in the Emerald Isle. A third new express design has been made famous in that a portion of the engines constructed from it were supplied, for the first time and almost certainly the last also, by German builders. These are the enlarged 4–4–0 superheater engines on the South Eastern and Chatham Railway, 10 of which were built by Borsig, of Berlin-Tegel, and the other 12 by Beyer, Peacock & Co.* Another locomotive event almost without precedent, in connection with the South Eastern and Chatham Railway, has been the locomotive "famine" early in 1914 which led to the purchase of 15 Stirling 2–4–0 express engines from the Great Northern Railway. The only other new express locomotive designs to appear during the past year have been that of Mr. Pettigrew for the Furness Railway, which possesses no features of special note, and a new 4–4–0 superheater of moderate dimensions built by Mr. Bowman Malcolm for the Northern Counties Committee section of the Midland Railway in Ireland.

* We are requested by Mr. R. E. L. Maunsell to state that while these engines have been constructed under his direction, the design was prepared by his predecessor, Mr. H. S. Wainwright.

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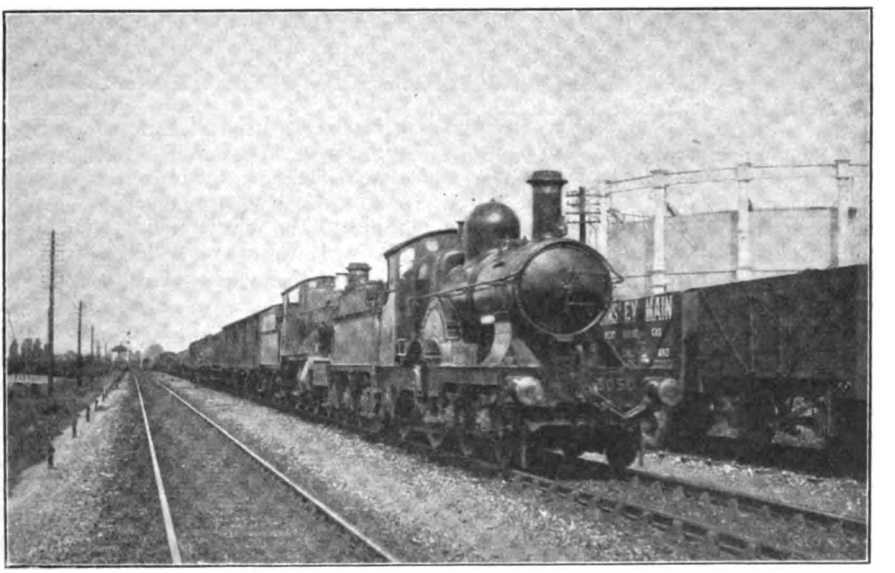
In the matter of tender goods engines there has not been such diversity. Quite the most interesting has been the superheater 2–8–0 or "Consolidation" design of Mr. H. Fowler, Locomotive Superintendent of the Midland Railway, for the Somerset and Dorset Joint line. This is the only case on record, I should imagine, in which a locomotive superintendent of a large railway has built for a smaller line coming under his *ægis* an engine larger than any running on his own system. This is, of course, easily explained by the severe running conditions of the Somerset and Dorset Joint Railway, which include long stretches of continuous grade as steep as 1 in 50, over which heavy coal trains have to be operated. The large 2–8–0 engines of Mr. Gresley's design appeared late in 1913, and so do not come within our survey. New superheater 0–6–0 engines have appeared on the Great Southern and Western Railway of Ireland, and a non-superheater variety on the Furness Railway, during the year under review. Mr. McIntosh's final design, before relinquishing the superintendence of the Caledonian Railway locomotive department, was a powerful superheater 4–6–0 type, with 5 ft. 9 in. wheels, intended mainly for mixed traffic service. Another important mixed traffic type of 1914 has been the H3, or enlarged superheater 2–6–0 class of Mr. Gresley's design on the Great Northern Railway, numbered from 1640 upwards.

Once again the majority of new designs introduced during the past year have been of tank engine types, and several of these are machines of remarkable size and power. First and foremost, of course, comes Mr. L. Billinton's 4–6–4 superheater engine *Charles C. Macrae*—undoubtedly the largest tank locomotive ever built for purely express passenger service. Another passenger tank engine of moderate size is the 4–4–2 type introduced by Mr. Glover on the Great Northern Railway of Ireland. Among tank locomotives intended for goods and mineral service, the 2–6–4 wheel arrangement—much prophesied at one time in connection with the London and North Western Railway, but turning out in that case to be the 4–6–2—makes its first appearance in Great Britain (although not in the British Isles) on the Great Central Railway, where it is intended to work heavy coal trains from the Nottinghamshire and Derbyshire coalfields to the Lincolnshire coast for shipment. The handiness of tank engines for work of this character, particularly when marshalling in colliery yards is included, is well known, and has already been put to the test on the North Eastern Railway Mr. Adams has



Photo] [*A. Richardson.*

GREAT WESTERN RAILWAY.

Goods train, near Oxford, headed by 4–2–2 engine No. 3050, *Royal Sovereign*, and 2–6–0 engine No. 4350.

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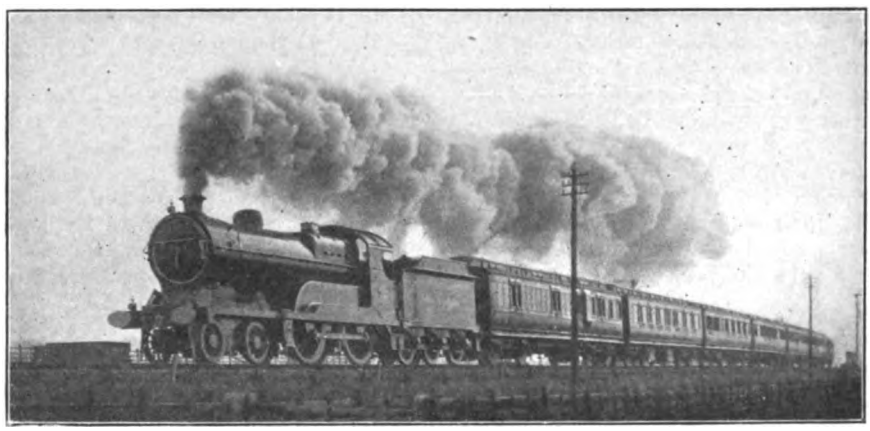
also introduced a very handsome 0–6–4 superheater design on the North Staffordshire Railway for the same purpose, and for mixed passenger and mineral service Mr. Pettigrew has built some new 0–6–2 tank engines on the Furness Railway. For shunting work Mr. Gresley has designed and built for the Great Northern Railway at Doncaster some 0–6–0 locomotives which are, probably, the first superheater-equipped engines of this character, while Mr. Hill has constructed some 0–4–0 shunting tanks of exceptional power—among the heaviest engines in this country running on four wheels, I should imagine—for service in Canning Town goods depot, Great Eastern Railway. A final important design, which should now be at work, is Mr. Watson's large 4–8–0 shunting engine for use in working the "hump" marshalling yard at Inchicore, Great Southern and Western Railway.

The year 1914, therefore, has been by no means barren of locomotive developments. In addition to new types, also, large additions have been made to the locomotive rolling stock of various companies from existing designs. Among express engines, the Great Western Railway has put in service 15 of the "Princess" 4–6–0 type, with four 15 in. cylinders. The London and North Western Railway has commissioned 10 more 4-cylinder 4–6–0 engines of the "Claughton" type, in addition to a further number of the useful superheater "Experiment," or "Prince of Wales" class, named after poets and men of letters. Ten further large superheater 4–4–0 express engines have been added by the North British Company to the previously existing two of this type, all of them receiving names out of the Scott novels—an original idea, consistently carried out by Mr. Reid, which is commendable and interesting. Another series of 3-cylinder "Atlantic" express engines has been built by the North Eastern Railway, making a total of 30 engines of this type, all of which are now included in class Z, as the ten non-superheater engines have now received superheater equipment.

The Great Eastern Railway has built ten further 4–6–0 express engines, and Mr. Hill has also equipped seven 4–4–0 engines of the "Claud Hamilton" type with the Robinson superheater, and sixteen of the re-built T19 type with the Schmidt apparatus. Superheater equipment, of course, goes on rapidly on many lines. On the North Eastern Railway I have noted in my diary 63 engines that I have seen so dealt with—19 of class R, 5 of class R1, 8 of class Q, 3 of class M1, 7 of class F1, 11 of class G1—all 4–4–0; 5 "Atlantics" of class V; 2 4–6–0 engines of class S1 and 1 of class S; and 2 0–6–0 engines of class C1. Moreover, the number is constantly being added to. On the Great Central Railway, in addition to numbers of 4–4–0 engines now superheated, I noticed at Marylebone recently a 4–4–2 tank so equipped, which is said to be doing very well. The majority of the 4–4–0 engines on the Midland Railway will shortly be superheated (86 of the re-builds have been dealt with to the time of writing); I saw also



Photo] [*J. Bradshaw.*

GREAT CENTRAL RAILWAY.

Royal Train passing Abbey Lane Sidings, near Leicester. Great Western rolling stock, Great Central superheater: 4–4–0 locomotive No. 429, *Sir Alexander Henderson.*

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No. 1000, the pioneer compound, at Derby the other day with superheater attachments, which seems to indicate that the compounds will similarly be included. Ten engines of representative 4–4–0 and 4–6–0 types are now receiving superheaters on the London and South Western Railway. Corresponding progress may be reported on the London and North Western, Caledonian, and other of the large lines, foreshadowing the universality in this country of superheater equipment—at least as regards engines intended for main line work, and running under continuous steam.

In now taking up the subject of performance, I am going to follow up the precedent set last January by giving details of my "best runs" of 1914. Although, perhaps, I have not succeeded in recording during the year just closed anything quite so phenomenal as the runs I described in the issue of a year ago, I have, nevertheless, enjoyed some exceedingly fine trips. Each of these is given in table form, in order that they may the better be placed on record. First and foremost among them is again a run on the London and North Western Railway—a run the more surprising in that no communication was made with the driver prior to starting, while the schedule was one which, although that of the "crack" express from Manchester to London, does not, on account of lightness of load, call for exceptional locomotive effort. The train was the 9.45 a.m. *ex*-London Road, and the engine one of the latest superheater 4–6–0's of the "Prince of Wales" class, No. 2293, *Percy Bysshe Shelley*, handled in most able fashion by driver J. Lamb, of Longsight. I was the more pleased to record this run in that most of my experiences with these engines have been secured north of Preston, so that this journey over the flatter grades south of Crewe fully bears out my remarks in the October issue as to the extraordinary capacity for speed displayed by the "Prince of Wales" class, despite the comparatively small driving wheels of 6 ft. 3 in. diameter. The load from the start was one of only three corridor 8-wheelers and two dining cars, *plus* a through corridor coach from Rochdale attached at Wilmslow; this represents empty weights of 173 tons and 203 tons, or full weights, with passengers and luggage, of 184 tons and 215 tons respectively.

To Wilmslow the running was not startling, as we were stopped momentarily by signal at Longsight Junction, and checked badly at Styal; having attached the Rochdale coach, we then left Wilmslow for London 4 min. behind time. Speed was picked up with great rapidity, Chelford, 4⅝ miles, being passed in 6 min. 25 sec., and a rate of 71·4 miles per hour being sustained for some distance between Goostrey and Sandbach. Mile-post 159¾, 16⅞ miles from the start, was passed in 17¼ min., so that "even time" had been all but achieved before we slackened for Crewe, which was passed very slowly. Up the ascent to Whitmore the engine went magnificently, accelerating to 51·1 miles per hour on the 1 in 330–250 to Betley Road, and only dropping to 49·3 on the 3 miles at 1 in 177 to Madeley. Then came a swift descent to Stafford, speed being maintained for some distance at 75 miles

L. & N.W.R.: MANCHESTER—EUSTON.
Engine: 6 ft. 3 in. 4–6–0 superheater No. 2293, *Percy Bysshe Shelley.*
Driver: J. Lamb, Longsight.
Load: *ex*-Manchester, 185 tons.
ex-Wilmslow, 215 tons.

Mls.	Stations.		Bkd.	Actual.
—	Manchester ..	dep.	9.45	9.45.00 a
11⅜	Wilmslow ..	arr.	10.00	10.4.10
		dep.	10.03	10.6.55
16⅛	Chelford ..	pass	10.09	13.20
25¼	Sandbach ..	,,	10.20	21.45
30⅜	Crewe (slack) ..	,,	10.26	26.50
35⅛	Betley Road ..	,,	—	33.40
40⅞	Whitmore ..	,,	—	40.20
49½	Norton Bridge ..	,,	—	47.50
54⅞	Stafford (slack) ..	,,	10.55	52.20
61¼	Colwich	,,	—	11.0.30
64⅛	Rugeley	,,	11.05	3.05
67	Armitage .. (signal stop)	arr.	—	11.6.15
		dep.	—	11.8.20
71⅞	Lichfield	pass	—	16.00
78⅜	Tamworth ..	,,	11.20	22.10 b
86⅛	Atherstone ..	,,	—	30.45
91⅜	Nuneaton	,,	11.33	35.50
97⅛	Shilton	,,	—	42.10
105½	Rugby (slack) ..	,,	11.49	50.10
113¼	Welton	,,	—	58.55
118⅞	Weedon	,,	—	12.3.35
125⅝	Blisworth	,,	—	9.50
128⅝	Roade	,,	12.12	12.40
136	Wolverton ..	,,	—	19.00
141¾	Bletchley	,,	12.26	24.05
148¼	Leighton	,,	—	29.55
156¼	Tring	,,	12.42	38.15
163⅞	Boxmoor	,,	—	44.35
170⅞	Watford	,,	12.56	50.15
177	Harrow	,,	—	55.30
182⅞	Willesden	,,	1.08	1.1.00 c
188⅜	Euston	arr.	1.15	1.10.55

a—signal stop, Longsight Junction, and check, Styal; b—p.w. check, Tamworth; c—severe p.w. check, Queen's Park.

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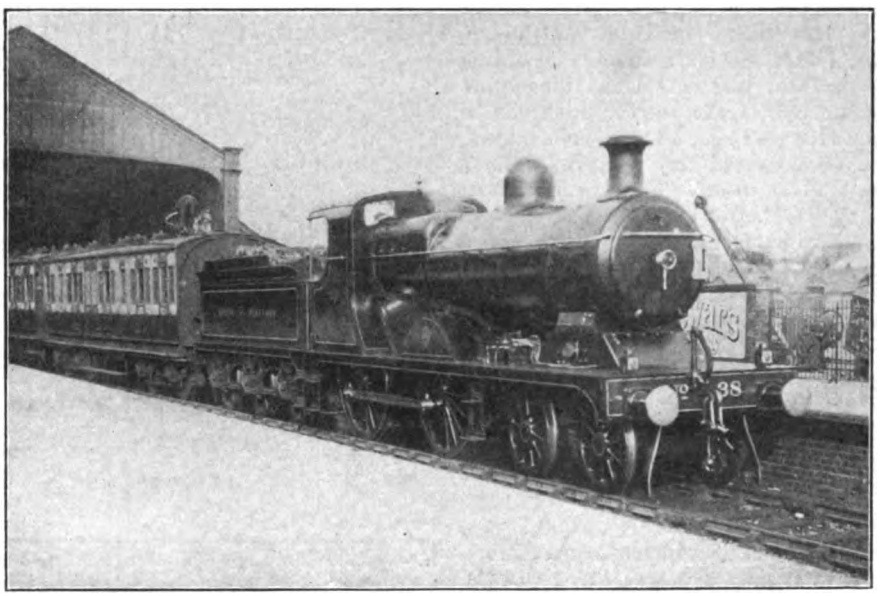
per hour in the neighbourhood of Norton Bridge—an astonishing exhibition on a grade which, save for 2½ miles of 1 in 391 from Whitmore, is nowhere steeper than 1 in 505. The time of 25½ min. from Crewe to Stafford was almost a record, and it will be noticed that over 6½ min. had been already gained on schedule time. Such exemplary caution was manifested by the driver when passing Trent Valley Junction—at a speed of 25 miles per hour!—that time was lost on the next stage to Rugeley, but we had again "got going" nicely beyond Rugeley, at 70·3 miles per hour, when we were pulled up by signal at Armitage. The 55½ miles attained, and the easy grades beyond to Weedon were covered at an average of 73·8; the slight ascent to Roade brought us down to exactly 60 miles per hour, and then on the 1 in 330–335 descent to Castlethorpe troughs we maintained for some distance a speed of 75 miles per hour. The gradually ascending grades which culminate in Tring summit reduced our speed by degrees; at Bletchley it was 69·2, at Leighton 64·3, at Cheddington 62·5, and finally at Tring summit 57·7 miles per hour. Now came the finest speed exhibition I have ever recorded south of Tring, the speed rising to a maximum level of 77·5 miles per hour, which was



Photo] [*R. J. Osborne.*

NORTH STAFFORDSHIRE RAILWAY.

6.10 p.m. Llandudno–Burton and Derby through train at Llandudno. Superheater 4–4–0 locomotive No. 38.

from Wilmslow to the point where we stopped, north of the station, had been covered in 59 min. 20 sec., inclusive of the very severe slacks at Crewe and Stafford, and the climb to Whitmore.

After a stop of 2 min., we started again for London, but a permanent way check beyond Tamworth was a further source of delay. From Nuneaton onwards, however, the running was superb. The average speed up the 1 in 330 to Bulkington was 54·5 miles per hour, and a maximum of 68·1 was reached before Rugby, where the usual slack was made. On the 1 in 364 ascent to Kilsby Tunnel a speed of 56·3 miles per hour was kept up for fully 3 miles, on a grade of 1 in 330-528. It was not, indeed, until steam was shut off at Sudbury that there was any pronounced "easing" of the engine, with the result that Willesden was passed a modest 7 min. in advance of time, no less than 9 min. 50 sec. having been gained on schedule from Nuneaton. Severe slacks for the various underground works in the neighbourhood of Queen's Park spoiled the conclusion of the run, but for all that we arrived at Euston over 4 min. early, having covered the 141⅜ miles from Armitage in 142 min. 35 sec. start-to-stop.

Now let us look at some of the features

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of this run. In the first place the gross time from Wilmslow to Euston, 176⅞ miles, was 184 min., the throughout average of 57·7 miles per hour including one signal stop of 2 min. 5 sec., two permanent way checks (one very severe), and three service slacks, the first two to 25 miles per hour each. The actual running time, deducting the duration of Armitage stop, was 181 min. 55 sec., a gain of 10 min. 5 sec. on booked time. As to net times, it is very difficult to estimate accurately. Taking merely the schedule times from Rugeley to Nuneaton, and from Willesden to Euston, the net time from Wilmslow works out at 176 min. 20 sec., or just under "even time" for the whole journey, allowing for the slacks at Tamworth and Queen's Park, and the stop at Armitage. But I have, under circumstances similar to these, timed the Rugeley-Nuneaton stretch in 4 min. less than this booking, and even admitting that the latter was an exceptional occasion, I think it would be fair to put the net time of the run under review as 173 min., with a "possible" time of about 170 min.—19 and 22 min. respectively under schedule time! By "possible" time I assume faster running through Stafford, from Nuneaton up. to Shilton and from Willesden to Chalk Farm. Thus this run demonstrated the feasibility of the much-talked-of 3 hours' time from Manchester to London, which I have not the slightest doubt that driver Lamb could achieve as a non-stop journey with this engine and load, and with but the minutest variation from these times.

Certain of the more spectacular intermediate times may be quoted. For instance, the time from Whitmore to Willesden, 141½ miles, was actually 140 min. 40 sec., inclusive of all delays, or 132 min. net, on the basis given above. The 69¾ miles from Welton to Willesden were covered in 62 min. 25 sec., at an average speed of 67 miles per hour throughout. From Crewe to Euston the gross time was 164 min. 5 sec., and the net 153; from Stafford 138 min. 35 sec. and 127 min. respectively; from Nuneaton 95 min. 5 sec. and 92¼ min.; and from Rugby 80¾ min. and 79¾ min. respectively. Although I travelled in the coach next the engine, it was remarkable to notice that the exhaust, save just on starting and for a short time afterwards, was practically inaudible—a revolution in respect to London and North Western practice that many will appreciate. Indeed, the able management of the engine reflects the greatest credit on both Lamb and his fireman, Rees, who deserve congratulations for this really remarkable effort. I should like to mention other fine London and North Western runs at this stage, but considerations of space compel the holding of these over until the next number.

For the next best item on my "list" I am indebted to driver Bailey, of Neasden, Great Central Railway, who afforded me the flying run on the 2.40 a.m. *ex*-Marylebone that was recorded in these columns in June,

G.C.R.: MARYLEBONE—SHEFFIELD.
Engine: 4–4–0 superheater No. 432, *Sir Edward Fraser*.
Driver: Bailey, Neasden.
Load: 180 tons to Leicester, 145 tons beyond.

Mls.	Stations.		Bkd.	Actual.
—	Marylebone ..	dep.	3.15	3.15.00
5½	Neasden Junction	pass	—	23.30
9¼	Harrow	,,	3.29	28.20
17¼	Rickmansworth ..	,,	—	36.15
23⅜	Amersham ..	,,	—	46.05
33¼	Wendover ..	,,	—	55.40
38	Aylesbury ..	,,	4.00	59.35
44⅜	Quainton Rd. Junc.	,,	4.08	4.06.10
48¾	Calvert	,,	—	11.00
59¼	Brackley	,,	—	21.30
69⅛	Woodford ..	,,	4.32	30.50 a
71½	Charwelton ..	,,	—	33.25
78½	Braunston ..	,,	—	39.45
83½	Rugby	,,	—	43.45
90	Lutterworth ..	,,	—	50.20
98⅜	Whetstone ..	,,	—	57.20
103⅛	Leicester (slip) ..	,,	5.04	5.1.30 b
108⅛	Rothley	,,	—	8.50
112⅞	Loughborough ..	,,	—	12.55
117½	East Leake ..	,,	—	17.05
125⅝	Arkwright St. ..	,,	—	23.50
126½	Nottingham (Victoria)	,,	5.26	25.30
128⅛	New Basford ..	,,	—	28.15
138¼	Kirkby	,,	—	39.50
146⅞	Heath	,,	—	48.25
152⅝	Staveley	,,	—	53.40
159¾	Woodhouse sig. stop	arr.	—	6. 1.00
		dep.	—	6. 4.25
164¾	Sheffield	arr.	6.12	6.13.40

a—p.w. check, Charwelton troughs. b—severe p.w. check, Belgrave.

1912. He is now in charge of No. 432, *Sir Edward Fraser*—one of Mr. Robinson's latest 4–4–0 superheater engines—and was, unbeknown to me at the time, driving this engine on the run with the 3.15 p.m. down "Sheffield Special" described in the issue for August last. This new record was made on the same train, and displays the same characteristics as previously, only in a much more marked degree. Its superlative

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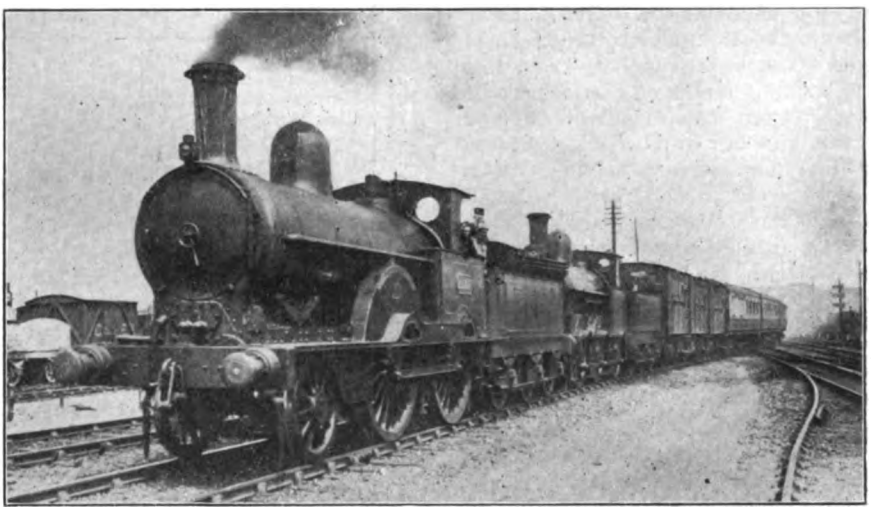
merit was enhanced in that the weather was exceedingly bad, a gale from the south-east being accompanied by heavy rain for the major part of the distance. The load of the train was as usual—four of the latest eight-wheelers for Sheffield—probably the heaviest standard stock in the country in proportion to the accommodation afforded—together with the Leicester slip-coach. This totalled with passengers 180 tons for Leicester, and 145 tons beyond.

The run was not exceptional in its early stages, although quite good. Approaching Neasden the speed touched 60 miles per hour, but the pace was eased a little over the junction, and on the ascent to Harrow, as steep at one point as 1 in 94, it fell to 45 where the usual slack was made, nearly 2 min. ahead of time. Beyond this point the booking on to Woodford is very severe, and we lost fractionally on it, despite fine uphill work. In fact, the minimum speed on each adverse stretch at 1 in 176, culminating respectively at Finmere, near Helmdon and near Culworth, was always exactly 56·3 miles per hour—no mean achievement even with so comparatively light a coach-load as 180 tons. The short intervening strips of downgrade—1¼ miles from Finmere, ¾-mile just before Helmdon, and 1¾ miles past Culworth—produced maximum speeds of 70·3, 65·2 and 71·4 miles per hour respectively. Beyond Woodford we were pulled up at Charwelton troughs for permanent way



Photo] [*W. H. Kelland.*

LONDON AND NORTH WESTERN RAILWAY.

Cambridge–Bletchley train leaving Cambridge; 2–4–0 locomotive No. 2175, *Precedent*, and 0–6–0 goods engine.

miles per hour. Accelerating rapidly from Harrow, a speed of 65·2 miles per hour was maintained over the little rise to Northwood, and steam was then shut off on the descent to Rickmansworth, which was passed at the usual cautious rate. On the long 1 in 105 bank that extends to Amersham, speed was maintained steadily at 39·1 to 40·2 miles per hour, and on the short rise at 1 in 125-157 beyond Missenden the minimum was 53·6; the intervening descent, as also the long 1 in 117 fall past Wendover into Aylesbury, each produced *maxima* of 71·4 miles per hour. The latter stretch was, of course, taken under easy steam, and speed was still further checked through Aylesbury. Nevertheless we passed Quainton Road Junction, repairs, and from this point the record nature of the run might be said to begin.

Down the long 1 in 176 descent to Braunston speed rose to and was maintained at 80·3 miles per hour. The little "hummock" on which Rugby stands reduced it to 63·8 miles per hour, but the maximum was again 71·4 miles per hour as we crossed the London and North Western main line. The 3 miles ascent at 1 in 176 towards Lutterworth resulted in a minimum speed of 55 miles per hour, but the final descent into Leicester produced a maximum of 81·8 miles per hour. To Leicester the net time was about 104½ min., and we were now well ahead of schedule, as we had need to be, in view of a very severe permanent way check at

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Belgrave. Speed soon rose again, however; past Loughborough we were running at 77·5 miles per hour, and this was again the sustained rate on the East Leake bank, the intermediate 2¼ miles up beyond Loughborough having lowered the speed to exactly the mile-a-minute rate. So we passed Nottingham, again ahead of time, in a net time of 127½ min. for the 126½ miles from London. As on the run recorded in August last, it was for the final stretch beyond Nottingham that the exceptional work was reserved. The short level stretch past Bulwell raised the speed to 57·7 miles per hour, and we then went right up the 7 miles of unbroken ascent at 1 in 130 to Kirkby without the speed once falling below 50·5 miles per hour—a truly astounding achievement. On the broken descent beyond we touched 64·3 miles per hour, and the final ascent to Pilsley reduced the rate to 56·3 miles per hour. In this way the time from Nottingham to Heath—22 min. 55 sec. for the 20⅜ miles, almost entirely adverse—was the fastest I have ever recorded, or seen recorded. After this we descended the long bank to Staveley rather more briskly than usual, touching 75 miles per hour, although slacking carefully through the latter station, and were in good trim for arriving at Sheffield from 4 to 5 min. early, when we were unfortunately stopped by signal at Woodhouse Junction.

We had covered the 159¾ miles from Marylebone to this point in 166 min., start-to-stop, or 163 min. net, and had the stop not been of such long duration, we might still have arrived on time. As it was, we were stopped dead for nearly 3½ min., and despite a most "game" ascent to Darnall cutting, and a smart finish with a maximum of 62·5 miles per hour beyond Darnall, we arrived 1 min. 20 sec. behind time. Judging by other runs of a similar character, I estimate the net time at rather under 170 min.—169½ min., to be exact—thus bringing this exceedingly fine run within the limits of the old 170-min. timing, and with a load fully 40 per cent. heavier than was ever carried in those days. For this capable work, under bad weather conditions, driver Bailey deserves great credit. Moreover, I believe that faster running at certain points south of Woodford and fine calm weather might have rendered possible a curtailment of these times by a further 5 min., thus bringing Sheffield within "even" time of London. On this run, again, some of the intermediate times are very interesting. For example, the 129 miles from Amersham to Staveley were covered in 127 min. 35 sec., or 124½ min. net, inclusive of slight service slacks at Aylesbury and Quainton Road, and more severe ones at Leicester and Nottingham. From Amersham to Arkwright Street the 102 miles were covered in 99¾ min., or 96¾ min. net, while from Amersham to Leicester, a distance of 79½ miles, the time was 75 min. 25 sec., or 74½ min. net. The fastest stretch was, of course, from Charwelton to Leicester, a distance of 31⅝ miles, which, although commenced and ended at a slow rate of speed, was covered in 28 min. 5 sec. It would hardly be possible to give a finer tribute to the uphill as well as downhill capacities of Mr. Robinson's latest express locomotive type than is afforded by this run.

I have had such a number of quite good trips lately on the Great Northern Railway that I have found it a little difficult to pick out even the two tabled herewith as the best of the series in the past year. But these were two very fine runs, both made on the 5.30 p.m. express from King's Cross to Newcastle. They differ considerably in detail. On the first occasion the start was late from Grantham, and driver Lightfoot, after rapidly making up the arrears, was content to keep more or less strict time from Retford on to York. But on the second run we had driver Parkinson, in charge of No. 1456, on whose consistently fine work I have

G.N.R.: GRANTHAM—YORK.

Distance.	Engine No. .. Type: 4–4–2 .. Driver .. .. Load	Schedule.	1436 Non-s'heater Light-foot 290 tons	1456 Super-heater Parkin-son 290 tons
Mls.		p.m.	p.m.	p.m.
—	Grantham dep.	7.31	7.33.50	7.31.00
6¼	Hougham .. pass	—	42.30	39.10
14¾	Newark .. ,,	7.47	49.40	45.55
21	Carlton .. ,,	—	55.00	51.05
26½	Tuxford .. ,,	—	8.0.35	56.15
28¼	Markham Box ,,	—	2.35	58.05
33¼	Retford .. ,,	8.07	7.25	8. 3.20
38⅝	Ranskill .. ,,	—	12.55	9.35
42⅜	Bawtry .. ,,	—	16.25	13.05
50⅝	Doncaster ,,	8.25	25.10	21.25
52¾	Arksey .. ,,	—	27.50	24.00
57⅝	Moss .. ,,	—	33.10	28.55
64⅜	Templehirst ,,	—	40.15	35.25 a
69	Selby .. ,,	8.47	46.10	42.40
75¾	Escrick .. ,,	—	55.50	51.55 b
82¾	York .. arr.	9.05	9.4.45	9. 3.00

a—severe signal check, Selby. b—very severe checks, Chaloner Whin and Holbeck Bridge, York.

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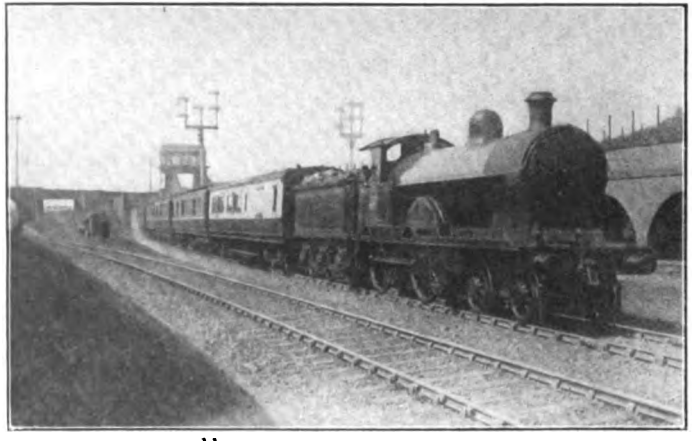
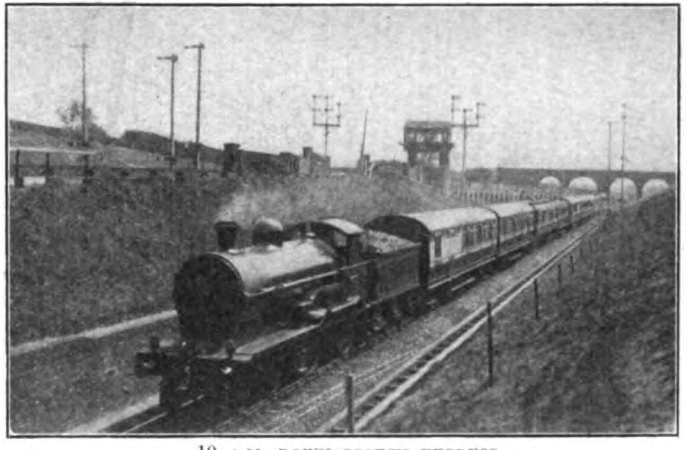
VIEWS ON THE LONDON & NORTH WESTERN RAILWAY, NEAR RUGBY.

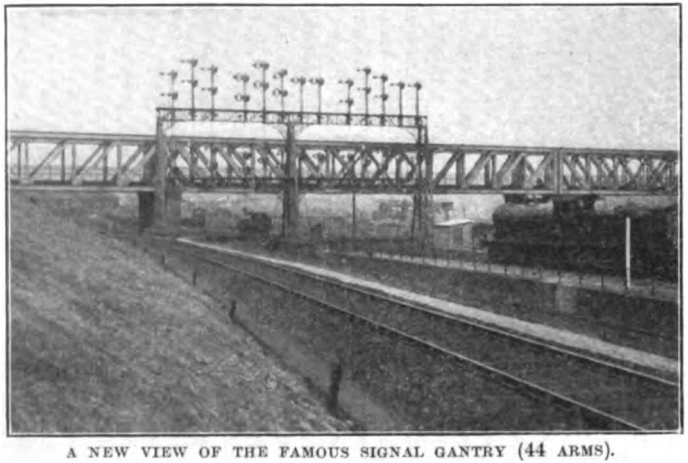
(Photographs by R. J. Osborne.)



11 A.M. UP LIVERPOOL EXPRESS.
Locomotive No. 365, *Alchymist.*



10 A.M. DOWN SCOTCH EXPRESS.
Locomotive No. 2151, *Newcomen.*



A NEW VIEW OF THE FAMOUS SIGNAL GANTRY (44 ARMS).

9.45 A.M. UP LIVERPOOL AND MANCHESTER EXPRESS.
Locomotive No. 1489, *Wolfhound.*

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had occasion to comment more than once in these columns. On this journey, although we started punctually, we were gaining on time almost throughout, and should certainly have made a record trip, but for signal checks.

A brief description of each of the runs may now be given. On the first No. 1436 started well, attaining a rate of 73·8 miles per hour near Claypole, and maintaining a high average of 70·3 miles from Newark on the level to Carlton. The ascent to Markham Box, including over 3 miles at 1 in 200, only reduced the speed to 51·7 miles per hour, and a maximum of 69·2 was touched on the subsequent descent to Retford. After this, as mentioned in the last paragraph, the running adhered closely to schedule, and is not worthy of special note, although the reductions of speed at both Doncaster and Selby—to 45 miles per hour in the former and less than 15 miles per hour in the latter—were unnecessarily severe. The total time for the journey was, as will be seen, 3 min. less than that booked.

Parkinson's run, however, beats most of my preceding records in this direction, and would have carried off the principal honours in the table that appeared in the last April issue, had it been made a little sooner. The start from Grantham was not quite so remarkable as was my "record" with the Great Central 3-cylinder "Atlantic" No. 1090, with 15 tons less load, when Newark was passed in "even time," but the difference was only one of 10 sec., while the maximum speed was the same in each case. From Newark to Carlton, however, the speed was the fastest I have yet timed, averaging 72·7 miles per hour, while the time of 25¼ min. past Tuxford also beats anything in my possession. It is also noteworthy that up Tuxford bank no lower speed than 56·3 miles per hour was registered. Unfortunately, the descent to Retford was made without steam—it will be seen that 25 sec. was lost on the time of the preceding run between Markham and Retford—but despite this we passed Retford nearly 3¾ min. before time. It also took some time to recover speed after Retford, and a slight check outside Doncaster, for which I could see no apparent cause, resulted in no time being gained between these points, although the Doncaster passing time also beats all my previous records, including those with substantially smaller loads. From Doncaster onwards, however, another fine recovery was made, which would have taken us easily through Selby 6½ min. ahead of time, but for a serious signal check approaching the station. Further signal delays spoilt the finish of the run, but still did not prevent us from arriving 2 min. early. The gross time was thus 92 min., and the net time 87 min., while with faster running from Markham to Retford, and through Doncaster, we could probably have completed the journey in 85 min. net. It is worthy of note that on this run, despite the slow running through Retford and Doncaster, Templehirst, 64⅜ miles from the start, was passed in 64 min. 25 sec., or almost exactly "even time."

On the Midland Railway one recent run stands out from most of the others that I have timed on that system during the past year. It was made on the Peak Forest line, from Leicester to Manchester, and was one of a series over that route that I hope to deal with ere long. The train was the 10 a.m. from St. Pancras, and the load a modest one of three 8-wheeled corridor coaches and two 12-wheeled restaurant cars, or 160 tons in all, including a fair complement of passengers and luggage, hauled by the 4–4–0 compound engine No. 1020. A start of customary Midland celerity was made, as indeed the booking of 22 min. to Sheet Stores Junction demands: the maximum speed at Loughborough was 69·2 miles per hour. We slacked slightly for Sheet Stores Junction, passing that point exactly on time, but immediately afterwards were stopped

M.R.: LEICESTER—MANCHESTER.
Engine: 4–4–0 compound, No. 1020.
Load: 160 tons.

Mls.	Stations.		Bkd.	Actual.
—	Leicester	dep.	11.49	11.49.00
4¾	Syston	pass	—	55.55
12½	Loughborough ..	,,	—	12. 3.15
20⅝	Sheet Stores Jc. (slack)	,,	12.11	11.00
23¼	Draycott (signal stop)	arr.	—	12.14.45
		dep.	—	12.15.40
26¾	Spondon	,,	—	21.30 a
29¾	Derby North Jc. (slack)	,,	12.24	28.30
34¼	Duffield	,,	—	34.00
39¼	Ambergate (slack)	,,	12.36	39.15
46¼	Matlock	,,	—	47.10
50¼	Rowsley	,,	12.49	51.55
53¾	Bakewell	,,	—	56.10
60¼	Miller's Dale ..	,,	1.03	1. 5.10
65	Peak Forest ..	,,	1.10	12.10
70¾	Chinley	,,	1.16	18.15
82½	Cheadle Heath ..	,,	1.28	29.10
87½	Chorlton-cum-Hardy	,,	—	33.00
90½	Manchester ..	arr.	1.40	1.39.35

a—signal slack, Derby North Junction.

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dead at Draycott, having covered the 23¼ miles from Leicester in 25¾ min. start-to-stop. This was not the end of our troubles, as further severe slacks ensued between Spondon and Derby North Junction, causing us to pass the last-mentioned point 4½ min. late. Our driver at once set to work to make up the arrears, and this on the most difficult section of the journey.

On the faint rise from Nottingham Road to Duffield we accelerated to 62·5 miles per hour, and the somewhat steeper ascent thence to Ambergate, mostly from 1 in 346 to 1 in 448, did not bring the speed below the mile-a-minute rate. After slacking carefully at Ambergate, speed again rose to 60 miles per hour on the short favourable stretch beyond, and did not fall below 56·3 up the 2 miles at 1 in 177-229 to Matlock. The ascent proper begins at Rowsley, and here No. 1020 did magnificently. Up the 1 in 100 grade which continues, with but very short intervals and variations, to a mile beyond Miller's Dale, we went at an almost unvarying rate of 45·5 miles per hour, while the final 1 in 90 stretch to Peak Forest summit, which was, I think, taken under a trifle more easy steam, brought us down to 33·6 miles per hour. As will be seen, the schedule to this point is fairly exacting, but we had regained on it over 2¼ min. of the arrears. Beyond this the unbroken steep descent to Cheadle Heath is very easily timed, and we negotiated the bank with corresponding caution, and many applications of the brake. Indeed, at Bugsworth we were only doing 53 miles per hour, but the rate was sustained at 65·2 past Hazel Grove, and increased to 70·3 at Cheadle Heath, so that we arrived in Manchester without difficulty—despite a very slow finish—25 sec. before time. We had thus gained 5 min., all but 5 sec., from Derby North Junction, and I estimate our net time, allowing the speed of contemporary runs between Sheet Stores Junction and Derby North Junction—a somewhat "over"-timed stretch—at 104 min. This very creditable run, therefore, was made in a net time 1 min. less than the "crack" timing of 1904, when the downhill speeds used to be much faster than was attempted on this trip.

What I consider as my best run on the North Eastern Railway during 1914 was made on a very unexpected occasion. I was travelling on the 11.20 a.m. *ex*-King's Cross, which, as is well known, travels to Scotland *viâ* Doncaster, Knottingley, Church Fenton, Harrogate and Darlington. Owing to mobilization (the run taking place early in August) we were much delayed *en route*, and reached Harrogate 40 min. late. Here our Great Northern "Atlantic" was detached, and we attached in its place a North Eastern 4-4-0 engine of class R, No. 476, not yet superheated. This is a locomotive type for which I have always had the greatest regard and, although this was doubtless a "spare" engine, and taking the place of an "Atlantic," it was pleasant to have this preference vindicated by a remarkably fine run. The load, by the way, was one of 315 tons, and so was no featherweight. For purposes of easier comparison with schedule times, I have tabled the run as starting from Harrogate at 3.32 p.m., whereas the actual time of departure was 4.12 p.m. A very favourable start is obtained from Harrogate, falling for 2 miles at 1 in 66; on this we quickly attained the mile-a-minute rate. From Bilton Junction on to Wormald Green the grades are not much easier than level, but then there is a 4-mile descent at 1 in 131 to near Ripon, on which we attained what is far and away my record speed for this stretch of line—81·8 miles per hour. Thus Ripon was passed in even time. On the gradually rising grades which follow on to Northallerton we continued doing well, passing Cordio Junction, 24⅛ miles, at greatly reduced speed, in 23 min. 20 sec. from the start. The steep ascent into Northallerton station then prevents speed being regained smartly, but we did well beyond to keep the sharp booking on to Darlington, although the stop was made by signal just outside that station, shortening the journey by ¼-mile. Still, we had run from Harrogate, 39¼ miles—including the long and severe slack at Northallerton—in 40 min. 55 sec., an excellent achievement for an engine of this moderate tractive capacity with a load of 315 tons I have

N.E.R.: HARROGATE—DARLINGTON.
Engine: 4-4-0 No. 476, class R.
Load: 315 tons.

Mls.	Stations.		Bkd.	Actual.
—	Harrogate	dep.	3.32	3.32.00
3⅜	Nidd Bridge ..	pass	—	36.35
6⅝	Wormald Green ..	,,	—	39.45
11½	Ripon	,,	3.44	43.30
17¼	Sinderby	,,	—	48.30
24⅛	Cordio Junc. (slack)	,,	—	55.20
25¼	Northallerton ..	,,	4.02	56.50
29	Danby Wiske ..	,,	—	4. 1.50
34¼	Eryholme	,,	—	7.35
39¼	Darlington (outside)	arr.	4.18	4.12.55

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no "Atlantic" record over the same stretch of line that can touch this, the only approach to it being a run on a similar occasion with an engine of the same class.

Finally, I want to draw attention to a very fine run on the North British Railway, behind one of Mr. Reid's latest 4–4–0 superheater engines—No. 416, *Ellangowan*. The train was fairly heavy, consisting as it did of seven of the latest corridor coaches and a 12-wheeled restaurant car, or 260 tons inclusive of a full load of passengers and luggage. From Waverley to Haymarket took 3 min. 35 sec., and we started thence on time. On the gradual ascent to Winchburgh the speed remained steadily at 57 miles per hour, and an unusual burst of speed followed—for an all but level road—the rate rising to 64·3 miles per hour at Linlithgow, and as much as 67 miles per hour at Manuel. At Polmont it was 63·8, at Falkirk 61·6, and at Bonnybridge 64·3 miles per hour, but after this the engine was very perceptibly eased, having covered the 30¼ miles to Castlecary in 33½ min., and being now well ahead of time Finally, despite the slowest of running past Lenzie and Bishopbriggs and a signal check outside Cowlairs, we arrived 1½ min. before time. With a continuance of the initial effort, of course, we should have been easily past Cowlairs in 46½ min., and a descent of the bank at the same cautious rate would have brought us into Queen Street in 52 min. from Haymarket, and 57 min. from Waverley. Such runs as these increase one's surprise that the North British service between the important cities of Glasgow and Edinburgh is not worked on a 60-minutes' limit, as the time of an hour would easily allow of one stop, and, indeed, of two, with loads not excessive, seeing that almost all these trains are now worked by superheater engines.

N.B.R.: EDINBURGH—GLASGOW.

Engine: 4–4–0 superheater No. 416, *Ellangowan*.
Load: 260 tons.

Mls.	Stations.		Bkd.	Actual.
—	Haymarket.. ..	dep.	4.5	4.5.00
4	Gogar	pass	—	12.20
10½	Winchburgh ..	,,	—	19.30
16	Linlithgow	,,	—	25.05
20¾	Polmont	,,	—	29.20
24	Falkirk	,,	—	32.25
30¼	Castlecary	,,	—	38.30
39½	Lenzie	,,	—	48.20 a
44¼	Cowlairs	,,	—	55.55
45¾	Queen Street ..	arr.	5.3	5.1.30

a—signal check outside Cowlairs.

At this point considerations of space compel me to bring my article to a close. Certain omissions will, of course, be noticed, but this is merely because I have had nothing of the really *exceptional* order to record during the past year. This is, for example, the case with the Great Western Railway, although I have received recently some correspondents' runs of unusual merit on that line, with which I wish to take an early opportunity of dealing. On the Great Eastern Railway I do not expect for some time a better run than that to which driver Cupper, on the 4–6–0 engine 1521, treated me on the 11.33 a.m. from Norwich to Liverpool Street, as described in the last issue. Such runs as these show that, despite wars and rumours of wars, locomotive running in this country is not yet a decadent quantity.

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A DISTRICT ELECTRIC TRAIN LEAVING HOUNSLOW TOWN STATION.

Railway Electrical Progress and Practice.

By "INDICATOR."

LAST month's article has elicited an interesting and comprehensive communication from a well-known electrical engineer concerned professionally with railway electrification. In introduction his letter may be quoted in full, and some of the points raised then further discussed. He writes :—

I have for many years been greatly interested in the problem of railway electrification, and there are one or two points which I should rather like to emphasise.

The problem of introducing electric traction on a railway has to be studied entirely on its own merits, and the question as to whether it will be advantageous or not, to introduce electric traction on any part of, or on the whole of it, depends entirely on the financial gains which can be expected to result therefrom.

As regards the question of system to be used, the fact must not be lost sight of that once a railway has adopted a particular type of equipment, it is difficult, if not impossible, at a later date to make any radical change. In the case of the electrification of the London, Brighton and South Coast Railway, the factor which must have governed the choice of system was, that it should be suitable for dealing with all classes of main line traffic as far as Brighton, as well as with suburban services.

A recent example of a similar case is that of the Pennsylvania Railroad, which, although it had adopted continuous current for the electrification of its terminal lines running into New York City, has, in the case of the electrification of its Philadelphia lines, adopted the single-phase system. This is in consequence of the electrification of this section forming part of a larger scheme which will eventually result in the electrification of the whole of its lines between New York and Washington, a distance of 230 miles.

Referring to your remarks about main line traffic and the multiplicity of systems, it may perhaps be of interest to point out that there already exist several cases of two systems being used in conjunction with each other. Thus, the New York, New Haven and Hartford Railroad, which has some 500 miles of track electrified, over which 100 electric locomotives are operating, in addition to a large number of multiple unit trains, and which is the pioneer of electric traction in the United States, has to operate over a great many miles equipped with continuous current low tension third rail, although the major portion of its system is equipped with the single-phase system.

Another example is to be found in Switzerland, where the electrification of the Löstchberg has recently been completed on the single-phase system, over which the most powerful electric locomotives in existence operate. At the station at Brieg this line joins the railway coming from Geneva, and here three-phase locomotives have to be put on in order to haul trains through the Simplon Tunnel.

I note that "Indicator" points out that some of the lines mentioned in the tables are really light railway lines, and it will be seen that only comparatively few of the lines so

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far electrified in this country have to deal with conditions such as are met with in standard heavy railway steam practice. Heavy railway electrifications, where goods, long-distance passenger and shunting services have to be dealt with, as well as local services, are not yet very numerous, but the results obtained are most encouraging.

The present position with regard to this is somewhat as follows:—

	Miles electrified (reduced to single track).	No. of elec. loco-motives.	No. of motor-cars.
U.S.A.	2,000	400	1,000
Continent of Europe	1,300	300	350
Great Britain ..	750	25	650

In conclusion, I would like again to reiterate that financial considerations, both as regards capital cost and cost of maintenance and operation, alone govern the question as to whether electric traction should be introduced in any given case, and as to what system should be adopted. Every problem must be studied on its merits and on its merits alone, no general systems are possible, and it is more than likely that uniformity of system will be found to be a practical impossibility.

There are many indications that electrification of main lines, and the use of powerful goods, as well as passenger locomotives, is bound to progress in the near future, and that will lead to conditions having to be dealt with, very different from most, if not all, of those met with in the electrifications so far carried out in this country.

The writer does not go quite far enough in suggesting that the question as to whether it will be advantageous to electrify a line depends entirely upon financial aspects. It is claimed by some authorities that the ventilation problem was a governing factor in the case of the Metropolitan and Metropolitan District electrifications, and that it is virtually impossible to work "tube" lines in other ways—the cable-operated Glasgow District Subway is the only example, not an attractive one either, of an alternative method—while modern traffic demands accelerated as well as increased facilities, this requirement also calling for electrification as the only satisfactory remedy against traffic depletion and the effects of road and other competition. Analysed, these conditions generally prove to be aspects of the financial question, so that the accuracy of the general statement is not affected.

On a main line basis, however, the problem, while still essentially financial, is not so clear as in the case of urban and intense suburban traffic. That is, it may still be good policy to electrify a line even although it is not desired to add a single train or alter the train services, and there are engineers who consider that for working goods traffic alone it may be worth while to change the method of traction. In those cases other factors than that of increasing and expediting train services apply, such as the general improvement of services, extending the scope of suburban equipment to cover the main line sections, preparing for electrification of a complete system, operating trains over very steeply graded sections which call for heavy expenditure in steam locomotive power and the constant use of powerful assisting engines, and the correlating of a motive power equipment suited to particular classes of traffic to the working of other traffic also.

So far we have only the London, Brighton and South Coast Railway electrification as an example of the first stages of a truly comprehensive scheme, the North Eastern equipment between Shildon and Newport exemplifying a freight traffic undertaking, but, as pointed out by our correspondent, there are many cases abroad which set forth the influence of such considerations.

Instances are to be found on certain railways in the United States which are operated over mountainous and steeply graded lines electrically with a view to the working of heavy freight and ore trains, the passenger traffic being quite secondary; the Giovi incline on the Italian State Railways; and, of course, the Alpine tunnel lines, including the new Lötschberg route and also the Simplon, while steps are being taken for electrifying the St. Gothard and Mont Cenis lines. There are also certain lengthy tunnels, such as the St. Clair, where, at a very early date, electric locomotives were introduced to haul complete trains—steam locomotive included—through the tunnel. On the goods side there are several important yards in the United States where train marshalling and shunting is performed electrically, while there is at least one colliery in the United Kingdom where the privately owned locomotive equipment, including seven or eight powerful engines continuously engaged, is entirely electric, supplied with current from overhead conductors. It has been suggested, too, that it would be advantageous for the South African Government Railways to electrify, not with a view to Cape Town and other suburban services, or indeed for passenger traffic except incidentally, but to enable heavy goods trains to be worked over the severe 1 in 30, 40 and 50 grades which abound on some of the main routes, and which have rendered necessary the exceptional steam locomotives in use

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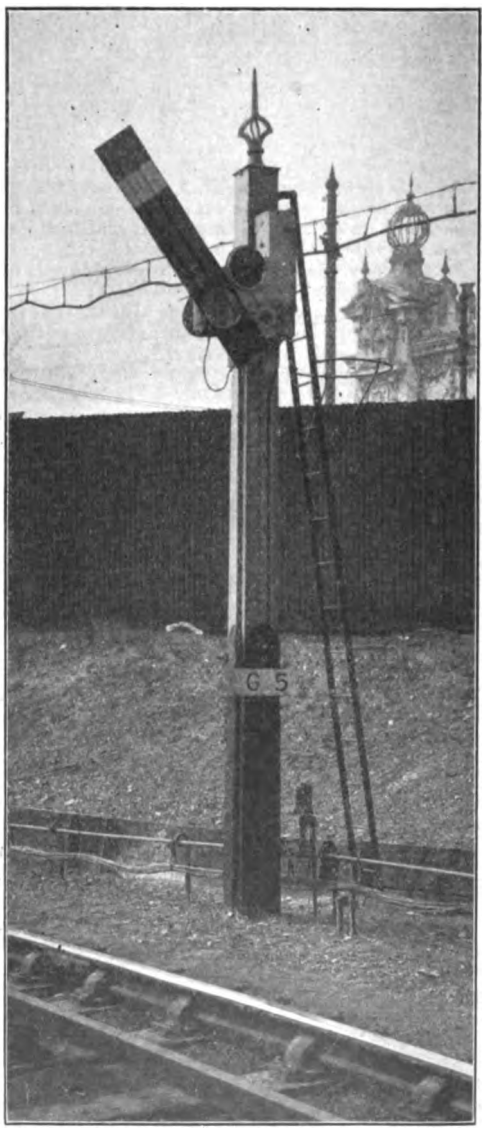
The New Zealand and some of the Indian lines have also been suggested as fields for similar applications, as also the Trans-Andes lines in South America.

It was perhaps hardly necessary to include the "light" or "tramway" lines given last month; but the object was to set forth the full record of electrification in the United Kingdom as far as lines which rank as railways are concerned, including also tramways operated by railway companies. On that ground they require inclusion, but not as examples of true railway electrification. The present situation is, however, a very favourable one from the electrification point of view for, outside London, the Lancashire and Yorkshire and North Eastern electric systems are by no means insignificant, and it is an open secret that the London, Brighton and South Coast equipment is a first step towards much greater developments. In fact, the Brighton programme already in process of realisation, the London and South Western suburban scheme, and the works now under weigh on the London and North Western and North London lines, in themselves will more than double the completed electric mileage, especially when the promised electrification of the Tilbury line is carried out by the Midland Company, besides calling for operations on a scale which will at least approximate to main line conditions, in view of the relatively lengthy journeys which they will provide for.

So far we have only two electric locomotives specially allocated to goods traffic, those used by the North Eastern Railway for working the Quayside line at Newcastle, though there are several electric locomotives employed for service use by railway companies, and a number of an industrial character utilised by manufacturing firms and at collieries, including those previously referred to, where a colliery yard is entirely worked in that way. But on the Metropolitan Railway it is a regular practice to use the standard electric locomotives for goods traffic between the West Hampstead yard and the Ray Street goods depôt near Farringdon Street station. This depôt, by the way, has the distinction of being the only one in the United Kingdom which is served entirely by electrically operated trains; but there is no reason why similar methods should not be utilised more generally, and no doubt they will be as electrification extends.

With main line electrification the use of locomotives will become essential, even if special set trains for express and definite services are constructed on the multiple-unit car principle, and the working of goods traffic will naturally follow. The difficulty that exposed conductor rails are dangerous in shunting yards is not a serious one. It is a simple matter to duplicate the collecting gear, and take current from overhead wires in these localities, while instances could be quoted where conductor rails are so protected that there is no risk or danger whatever.



UPPER QUADRANT SIGNAL AT WOOD LANE, CENTRAL LONDON RAILWAY.
McKenzie, Holland & Westinghouse Power Signal Co., Ltd.

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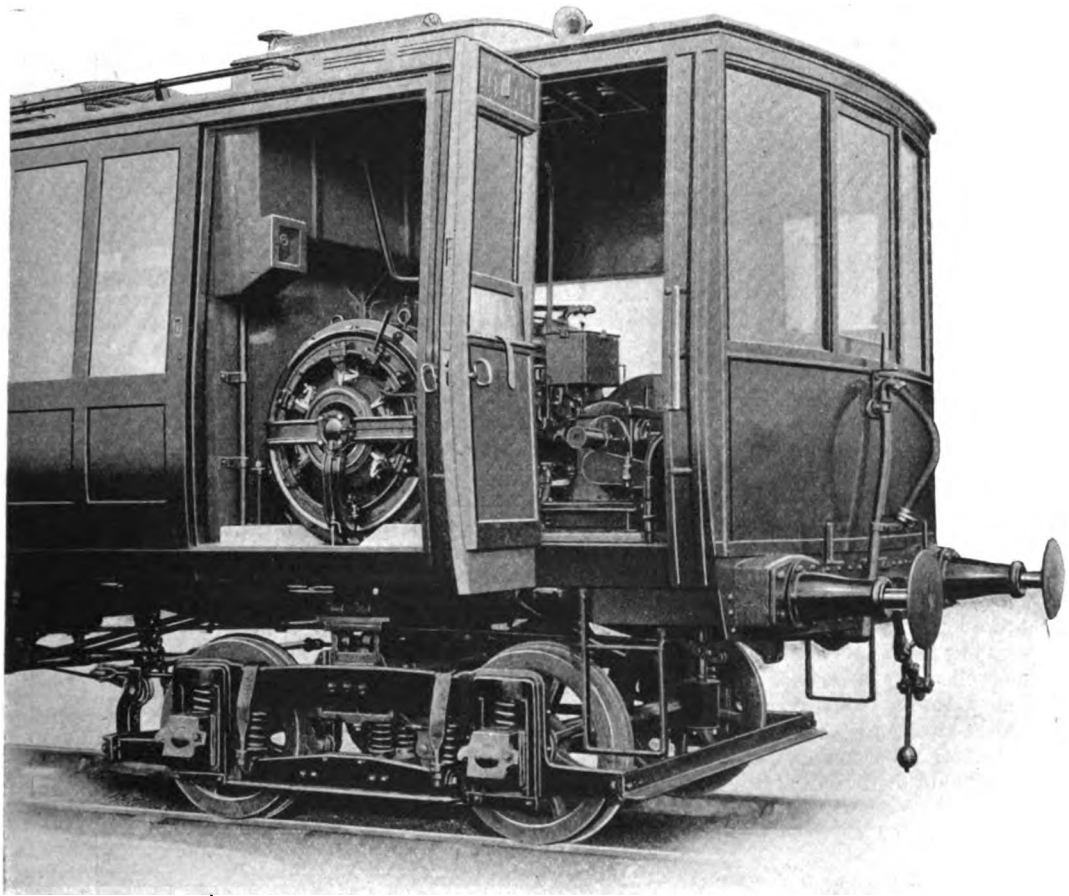
One method is to place the conductor rails *underneath* a protecting covering, the collecting shoes bearing on the lower surfaces instead of the upper ones as usual. Even with ordinary exposed conductors, shunters and others engaged become so used to them that they seldom or never come into contact with them, though it is desirable to provide against stumbling in badly-lighted places, or as the result of accident.

In the United States several of the big goods yards are now operated entirely electrically, the locomotives being triple-crewed, in three 8-hour shifts, and thus working continuously from, say, Monday morning until Saturday night, or whatever the actual period may be. A weekly overhaul on the rest-day is generally sufficient, while for heavier repairs the usual method is to remove a damaged motor truck intact and insert another, so that the locomotive is quickly back in service, the truck taken out receiving attention at leisure ready for replacing the next failure in its turn.

So far electrification has progressed mainly in connection with the working of intense passenger traffic, because that field entailed on the one hand the most serious financial aspects, and on the other hand offered the greatest financial possibilities. The problem has been, in fact, that of the tramways over again—the need for operating a large number of travelling units, with relatively large carrying capacity, at frequent intervals and very considerably expedited, together with a few modifying influences. There is also



GENERATING PLANT, WESTINGHOUSE PETROL-ELECTRIC CAR, GREAT CENTRAL RAILWAY.

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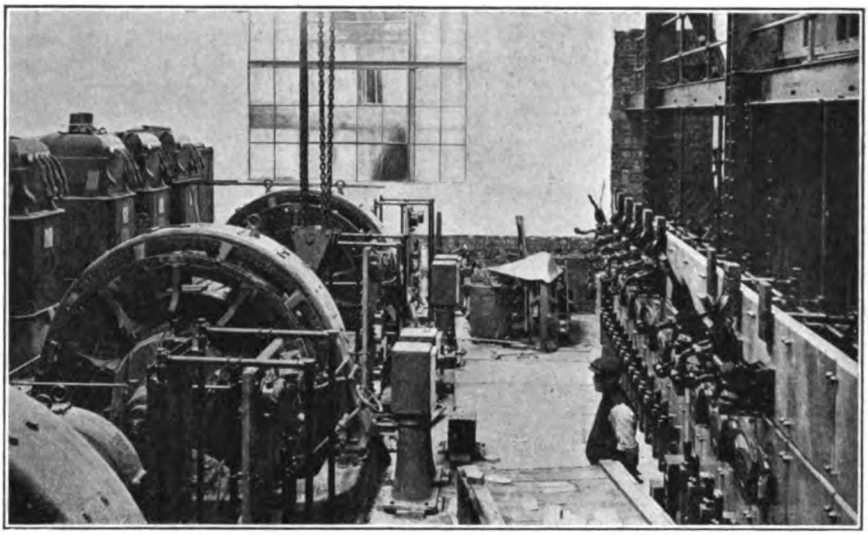

Photo] [*Newspaper Illustrations.*

SUB-STATION AT KILBURN PARK, QUEEN'S PARK EXTENSION, LONDON ELECTRIC RAILWAY.

the need for cheapening fares and meeting serious competition. Now, as pointed out by our correspondent whose letter is quoted above, the situation is widening very much, and main line electrification is by no means a remote expectation. The problems are different, the financial aspects are different, and the machinery and system of operation may be different. In favour of its realisation, however, is the fact that electrification under existing steam conditions has its advantages as well as its drawbacks, though the latter may usually be overcome by adapting methods to new conditions. Electrification is sometimes a means of averting downgrade tendencies or reviving failing fortunes, while the necessity for heavy capital outlay for conversion may not be altogether prejudicial seeing that capital for such purposes may sometimes be more easily raised than for more ordinary purposes, especially when future possibilities offered are considerable.

While there is no immediate prospect of the definite displacement of the steam locomotive, and probably it will still be a prime factor, if not the prominent factor it is now, in railway transportation fifty years hence, the question will have to be faced whether it will not, in some instances at any rate, be preferable to adopt what seems to be the transportation machinery of the immediate future while it offers special

ELECTRO-PNEUMATIC POINT MECHANISM, WITH SPECIAL THROUGH-RUNNING RAIL CONSTRUCTION, AT LIVERPOOL STREET, CENTRAL LONDON RAILWAY.

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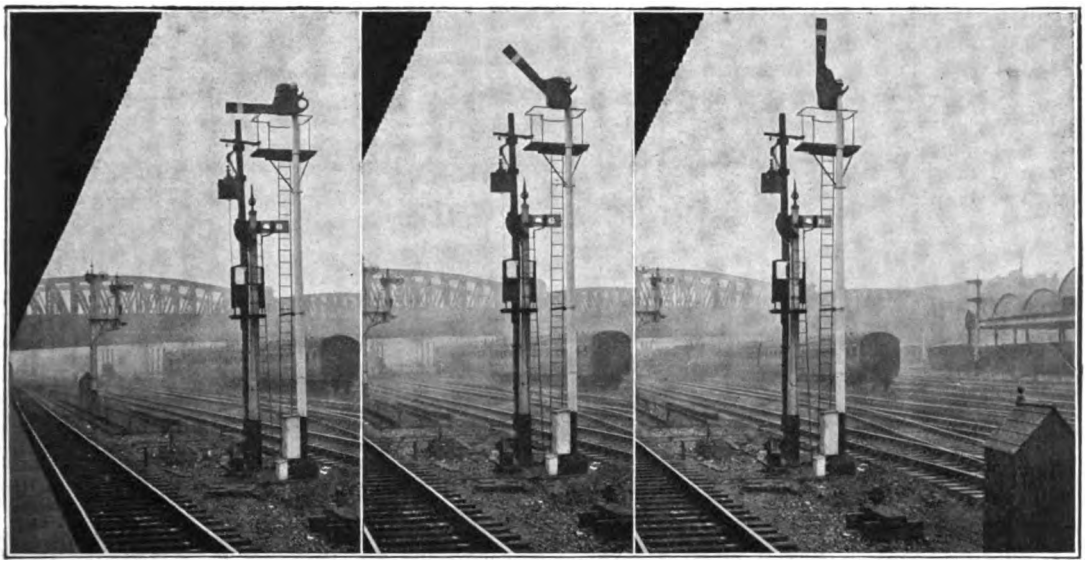

"STOP." "CAUTION." "PROCEED."

New Three-position Signal at Paddington, Great Western Railway.

possibilities, instead of waiting until conditions enforce development on these lines under less favourable conditions. This subject must be left for this occasion, though the more one deals with it the more opportunities it seems to afford for development, and in concluding this contribution it is necessary to refer to certain developments in signalling practice, though other topics must be left for another article.

The use of upper-quadrant signals on the Metropolitan Railway is now fairly generally known; but there are strong indications that the policy is likely to find favour in the United Kingdom on a wider basis. An illustration is given of an upper-quadrant signal at Wood Lane, Central London Railway, and it is quite probable that when the Ealing Extension is completed it will be signalled in the same way.

But the most interesting feature is the installation of a three-position upper-quadrant signal outside Paddington station, on the Great Western main line. This is further remarkable in that it is a true American signal, with tubular steel pillar and what is termed "top-mast" mechanism, and red, yellow and green spectacles. For some time there has been a three-position lamp signal at Edgware Road, Metropolitan Railway, but that was introduced for a special purpose, and it is not "three-position" in the sense that it combines the work of a "stop" and a "distant" arm. That at Paddington is therefore the first three-position semaphore two-block signal in the United Kingdom. We are indebted to the *Great Western Railway Magazine* for the illustration of this interesting signal, shown in three positions. A full description thereof is given by our contemporary.

It is erected beyond the Bishop's Road bridge, alongside "A" excursion platform, and applies to the down main line, to which it is an advanced starter. In the horizontal position it is a "stop" signal; inclined upwardly at 45°, with a yellow light, it indicates that only one section ahead is clear; raised vertically, with a green light, it combines the function of a distant signal, a second section being clear. It remains to be seen whether in practice this type of signal will be considered as sufficiently clear for general adoption, though as this is a slow-speed starting division it will not be more than an approximate guide as to distinctiveness for high-speed observation; but the mere fact that such a signal has been installed opens out possibilities of important developments in British railway signalling.

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Leaves from the Log of a Locomotive Engineer [No. XXVIII.].

MEIER OF METZ.

By ROBERT WEATHERBURN.

Hitherto I have carefully abstained from giving any sketch or written account of one of the most interesting characters I have met with. The reader will perhaps realise the reasons as he proceeds, and may, or may not sympathise with the man. Yet before coming to a conclusion I would ask that the times, circumstances and provocations acting on a nature differently moulded to the common, be duly weighed, and considered. Albeit the man and his personality I can vouch for.

ON my presenting my letters of introduction to the chief authorities — Colonel Volkmar and Major Hüster of the German State Railways in Elsass Lothringen, Alsace and Lorraine—in Metz, in the year 1874, I was received with the marked reserve and punctilios so characteristic of the German official staff, and after the main points had been settled was given to understand that whilst every facility would be given me as regards convenience and space in the running sheds at Montigny-sur-Metz—some little distance outside the fortifications—for the erection of the English-made locomotives ordered by them, that I must not expect any assistance or help in the way of labour or tools; or in other words I must rely on my own endeavours to obtain the necessary men, the reasons assigned being that they could not spare any hands from their own over-pressed workshops.

In explaining this, it is needful for me to state that a large proportion of the workmen under the old *régime* had preferred the alternative of leaving their homes and employment rather than enrol themselves as German subjects. This was certainly not a great loss to the conquerors, but something of a gain, as was shown by the great rush of skilled and unskilled labour which set in to the newly-acquired provinces from all parts of the German Empire. Many were of the usual flotsam and jetsam ever to be found hanging around all industrial centres and large towns, among them being a not inconsiderable number of disbanded soldiers. The majority were largely influenced by the easier climatic and other conditions obtainable in so unsettled, yet eligible a country. The most qualified and reputable were secured by the authorities to fill the places vacated by the recalcitrants.

Those of the old—French—staff who elected to remain, and become German subjects in order to retain their employment, were mostly men who had some landed or property interests, or social and domestic ties that weighed against their aversion to their conquerors and the military service it would imply. It would be difficult to imagine a more unhappy community, for such election had neither the advantage of securing German friendship, nor equality, whilst cutting themselves hopelessly adrift from old friends and associations, and being looked upon and treated as renegades.

My resource was the residuum left, which had been well sieved of all likely men. It may not be generally known that all "gesellen" (tradesmen) in Germany are required to carry an "Arbeit Buch," in which it is stated when, where, and by whom the possessor was last employed, together with a police signature. It is not legal to employ anyone who has not this in his possession.

One morning, when proceeding from my house at Sablon, a small village laying under the guns of Fort St. Quentain, to the old French running sheds at Montigny, I was accosted by a man of about 34 years, who was evidently waiting for me. He offered his services as a "schlosser" (fitter). The German word "schlosser" has a wide application; its literal meaning is lock-maker, but it is indiscriminately applied to any artisan engaged in the mechanical trades. I wanted a few locomotive fitters badly, and liking the looks of the applicant, I asked him for his "Arbeit Buch," which

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appeared in order. In answer to my further questions he stated that he had formerly worked for the French company, and if I required further references as to ability, Brigadier (foreman) Laudverlin—one of the old staff who had elected to remain as a German subject—knew him and the class of work he could do.

From the first there was something in the aspect and manner of the applicant that appealed to me. I am not readily impressed or influenced by a casual, but this man struck me as being of more than common character. He was not imposing or grandiose, a little above the common height, shapely but compactly built, with shoulders broad and like those of a middle-weight boxer in training, spare of flesh, and as sinuous and graceful in his movements as a panther. His general air of seeming independence, almost amounting to indifference, was so different to the general run. His face was of the pure Latin type, somewhat thin and as I at first thought stolid and wanting in expression. On this point I was soon to be enlightened. His nose and heavy moustache were most striking features; the latter lay right across and beyond his face, pandour like. Altogether he gave me the impression that he was not a man to be trifled with, and of great strength and agility, as the sequel will show. I took him on condition that he gave satisfaction. When could he start? At once, I replied.

On that and several days after I noticed that the usual civilities of foreign workmen on entering, or leaving, or momentarily assisting, were neither asked for on his part, nor extended to others. A mutual disinclination to fraternise and to avoid each other seemed to prevail. There was some mystery or secret which I did not know. He was always at work and to time, never smoked on duty like the others, and apparently did his work thoroughly and to my satisfaction. In my perplexity I went to consult the Brigadier, whom I partly knew, and inquired the character of Meier. He assured me that he was able and trustworthy, and, putting his finger on his lips, also honest and steady. But he appears unpopular and disliked by all, I remarked. "Well, that is not his fault, Herr Weatherburn. That does not make him the worse workman. Ach! well, Meier is a man," and with that conclusion I left him.

Some days after I received the usual periodical visit of inspection from Colonel Volkmar and Major Hüster, when the latter abruptly pointed out Meier to his chief. The purport of his words I did not catch, but was asked at once when I had taken him on. I told them, and inquired whether there was any reason why I should not? Major Hüster, after a short conversation with his chief aside, said it would have been better had I consulted them before doing so. I reminded them of their former instructions as regards taking on hands. No further reasons being vouchsafed they left me in still further perplexity as to their meaning. Meier's industry and devotion to duty with his evident desire to give satisfaction in the end established him in my favour and confidence and to be trusted, the more so as the evident boycott on the part of his fellows did not seem to influence him in the slightest. When away on trials I invariably left him in charge, and found him scrupulously trustworthy.

One evening when passing rather later than usual through a street in Montigny which was largely inhabited by the railway workmen, I noticed Meier in front, and heard the shrill voices of several youngsters crying out "Da geht der Spion. Da geht der Spion." At the time I did not understand to whom it applied, but this and other things speedily brought it to my mind later on.

One day I had taken him with me on a trial run of one of the engines in order to assist if required. At that time there were no power brakes and all brake blocks were made of wood, and were ground down by a gradual application until a general and equal bearing or bite was obtained, and then looped, or coupled up to the best advantage. For this purpose we made a halt at one of the smaller stations. The driver, ignoring the fact that Meier was still underneath, hurriedly put the engine in forward gear and opened the regulator. I noticed this at once and I immediately shut off steam and opened the cylinder taps. Fortunately the engine had stopped on the dead centre and did not move. I expostulated with the driver and told him that he might have lamed or killed Meier. "And a good job too," he answered, with a brutal laugh, in which the inspector joined.

On our return journey some two hours later, when trying the variable exhaust, which worked somewhat stiffly, I instructed Meier to oil the moveable vanes and links, an easy task when running slowly with a light head of steam by opening the smoke box door sufficiently and using the long feeder. The

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driver and inspector heard my instructions and saw him at work. Then the steam jet (at that time a simple bent pipe leading into the foot of chimney) was suddenly and viciously put on by the driver, which partly smothered Meier with soot and condensed water and might have caused a nervous man to have lost his hold. In spite of my remonstrances this episode and the condition of Meier and his clothing seemed a matter for jest and mirth. Fortunately Meier was riding on the outside footplate, and was unaware of the real facts.

Some time previously I had been requested by Major Hüster to employ the son of a Metz hotel proprietor, an acquaintance of his. This big brawny son of a Bavarian was of little use, beyond smoking and idling his time away. He was lost to reproof, and I was wondering how I could best rid myself of the incumbrance without offending Major Hüster, when the difficulty was solved by Meier.

Whenever I had an engine in steam in the sheds for the purpose of testing the joints, injectors, etc., before trial, it was my invariable custom at and during the dinner hour to put Meier in charge, with instructions not to allow anyone on the footplate, so as to prevent any tampering with cocks or levers.

On the occasion in question, I was comfortably smoking my big German pipe after dinner in the office apportioned to me, when I heard angry voices in dispute, speedily followed by the unmistakeable sounds of a struggle, and then by a muffled cry. On getting to the engine I saw the tall bulky Bavarian on his back in the coal space of the tender, with Meier at his throat throttling him. He was rapidly becoming black in the face, and was in a partial state of collapse. Realising the urgency of the case, I strove by command and strength to separate them; but Meier's fingers seemed to be glued to the man's gullet, and my efforts for a time seemed powerless to prevent a catastrophe. Meier himself appeared to have undergone a complete change from the self-possessed man I thought him to be, to the uncontrolled panther suddenly let loose. All efforts and remonstrances seemed unavailing and fearing the consequences, I at last had recourse to the old-fashioned garotting hug and literally choked him off; only just in time, as it took some anxious minutes bathing the Bavarian's face and otherwise treating him before he came thoroughly to himself.

Egged on by some of his mates, and relying on his strength and the patronage of Major Hüster, he had forced his way on to the footplate, and regardless alike of the engine being in steam and of Meier's remonstrances, commenced to move the levers. Meier at once seized him, and he retorted with a blow in the face. This had liberated the devil which more or less lies perdu in every man. Meier had then seized him by the throat and flung him into the tender, and had I not come to the rescue, and actually used brute force, would undoubtedly have choked him.

As it was the episode resulted in a very unpleasant fifteen minutes between myself and Major Hüster, who demanded Meier's instant dismissal. Yet to his credit, be it said, when the circumstances were explained (which constituted a serious offence on the part of his protegé), and the further declaration on my part that I alone must be responsible, he reluctantly gave way.

To explain further, on the fourth anniversary of the battle of Gravelotte, I and my colleague (Gregg) who had come from Antwerp (where he was stationed) in order to visit me, determined to take the train on the newly built railway to Amanvilliers, and thence on foot visit St. Privat and follow the route of the German army to Gravelotte. I told Meier to accompany one of our engines to Ars-sur-Moselle, and meet us at a stated place on the battlefield. The day was terribly hot and in that respect similar to that experienced on the day of the battle, August 18th.

After leaving St. Privat by way of "St. Marie au Chene," we hailed with delight the appearance of a wayside Auberge, and entering, asked in German for a litre of wine. The landlady, who seemed by no means pleased at our advent, assured us that they were out of all liquors. At this totally unexpected reply I inveighed against their want of hospitality in good honest English. This seemed to provoke the landlady to the query whether we were from Metz? Yes, but really from England. The good dame abruptly left, and almost as speedily returned with what proved to be an excellent bottle of wine, apologizing in a patois which was less intelligible than her actions, for not having known it.

I instance this to show the deep-rooted dislike then felt by the natives to their conquerors. Refreshed and enlightened, we proceeded by the chausee, guided by the numerous white crosses which marked the

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burial place of the dead, as well as the route of the Germans. At length we reached what to us appeared to be the scene of the great slaughter, judging by the many memorials (Denkmals), and found Meier sitting on a road side heap. Raising his cap in salute, he pointed with an embracing sweep to the field and hills bathed in the hot sunshine, and said "Gravelotte."

No better guide could have been found, for as we proceeded up the hills that formed the centre of the French position on that memorable day, he halted, and showed us the route of the main column of the Germans, and their flanking parties, and the broad undulatory hollow between the woods and roads where the concentrated rain of chassepot and mitrailleuse bullets had built up a wall of German dead and wounded more than breast high. How the breeches of the chassepot rifles through the rapid and continuous firing became so hot as to be no longer reliable. Then with a look of ineffable disgust and hatred, he finished by saying "we were tired of killing, and then came their 'drang und sturm.'" "So you took a part in that day's work, Meier," I remarked? "Yah, ich war da." "Meier, you are not much beloved by the workmen, and I heard the young boys of Montigny shouting 'Da geht der spion.'" In a moment I realised by the sudden change in his features and the bristling of his huge moustache, that I had the key to the mystery of his isolation by the Germans. Striking his chest with his clenched fist, he said, "Ich bin wohl ein spion gewesen, Herr Patron; I acknowledge it, and much more than they know. Herr Weatherburn, you have been my friend as well as master. I will tell you, for although the war has long been over, the German rarely forgets and never forgives—nor do I."

"Sit down, Meier, we have nearly two hours to spare before the train is due to leave Ars-sur-Moselle, and tell me how it was you took up with the spying business?" And this is part of what I heard as we obtained what shelter we could from the heat. But the pen at best is a poor medium wherewith to describe the place and man, let alone the interpretation of voice, emotion and gesture.

"I was born in the province by the Luxembourg frontier, and the French and German tongues are alike to me, but I am French, body and soul, so was my father. I hardly remember my mother, but was sent to the workshops of Montigny as an apprentice to fitting, and served my time there. Ach, those were happy times! I knew every village road and byway for miles around, and was a welcome visitor on feast and fête days. The war broke out. I do not know why, or who was to blame. But you ask, why did I become a spy? Oh, yes, I had bitter reasons for hating the Germans."

"Would you believe it, my father was shot, murdered, on his own doorstep, by order of Commander Kutner of the Commissariat, and why?—for striking a pig of an unter officier who had wilfully maimed one of his best horses which had been commandeered. Why did I become a spy? Because my sister, who managed his house, and all that was left to me, was brutally assaulted by Uhlans some time afterwards. When I heard I went home, but the homestead was broken up and plundered, and none could tell me the whereabouts of my sister. I was homeless, I had lost all. In rage and agony of mind I sought out the nearest French commander and told my tale, and proffered my services. Anything to be of use in the locality. I told the officer into whose hands I was placed, that no one knew the country better than myself, that I spoke both languages, but above all I had the language of hatred, and that was enough."

"I became a spy, and why not; it served both purposes, myself and France. Now I had something to do, changes of character and places. The interest and thrill of responsibility with personal danger sharpened me up. Every safe lurking place that I had known in my former life in the woods and forest lands I visited and prepared. Here and there were stored such changes of dress as I might require. Enough money was allowed me to procure what was needed, but my chief reliance was my own strength and agility. Every villager for miles round and about Metz could tell you that I was the chief wrestler and runner at the fetes. No; I do not boast, for I have no love for the dog that can only bark. And these qualities served me better than any others."

"At first I was employed to ascertain the movement, number and equipment (guns) of regiments and brigades. I have done 40 miles in a day on foot, and hung on to a stirrup for another 15. I was employed to report on the armies investing Metz and their communications and provisions; living and sleeping where I could, but never, if possible, losing contact with either side. General Canrobert was my real chief at one time, and thrice I carried messages, both oral

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and written, from him to Bazaine in Metz. On the last occasion I got into the Prussian lines disguised as a German soldier; sat and smoked by their camp fire until a fox-eyed unterofficier sat down, and quietly questioned me as to why I had wandered so far away from my bivouac. Their arms were piled. Two sentries stood about 200 yards apart in the darkness. I rose and coolly shook the tobacco carelessly out of my pipe, and taking him by the arm smilingly said: 'come, and I will show you our position.'"

"Fortunately we were alone, the others not hearing or heeding our conversation. When clear I pointed towards some distant watch-fires and suddenly back-heeled him, and as he fell kicked him in the wind, and dashed off in the darkness towards the Moselle, not more than 150 metres away. I was fortunate to get nearly there before the alarm was given or a shot fired. Slipping off the Prussian tunic, the facings of which had caused the suspicion, I took to the water and dived and swam towards the distant city as quickly as possible."

"Shots were now being fired at random, and I knew they would be searching the water on both sides of the river, but the darkness was all in my favour. Wading at times under the bushes, and swimming as low as possible in the deep water at others, I at last got well within the French lines, and demanded of the startled pickets to be taken before the officer of the outposts, by whom I was sent under guard into the city, where some two hours afterwards I was taken into the presence of Marshal Bazaine."

"Bazaine, *cochon Traiteur*, who lived through the siege regardless of the curses and execrations of the starving populace and soldiery; his house guarded against any attack from the discontented by a company of Spahis and two mitrailleuse at the entrance; seemingly content to pass the fateful hours under the fascinating evil eyes of his Mexican wife, the sorceress whose spell the women vainly tried to pray away in the cathedral. I gave him my message, and the following day received his authority to leave with a reply. That night I left the city by swimming the river Seille to return to my place of retreat, and passed the message on by sure hands to General Canrobert. Ach! the spy's life, beyond the reproach, is not all honey and nuts. Hardships and danger can only be known by experience."

"See!" he exclaimed, pulling up his sleeve and showing the scar of what had been a nasty wound, "that laid me up in a cave in the woods of Bondy for nine days, among toads and vipers and with a half litre of milk and a stick of bread daily sent or brought me by an old friend at the risk of his life. Yah, I worked harder then than at any other period of my life, and never knew for an hour what my fate would be. But I had the satisfaction of knowing that as a spy I did my duty to my country and myself."

"How, as regards myself, I will tell you. Metz fell and I joined the Avengers (Franc Tireurs), who were busy on the skirts of the German armies, for I knew how to handle a chassepot, and where they and ammunition could be found." "Did you ever meet with Bossuet?" I asked. I may here inform the reader that Bossuet was a sort of local leader, or hero of the "Franc Tireurs" of the West, of whom I had occasionally heard. "Yah, Herr Patron, I know him," he remarked hesitatingly. "But," I remarked, "he was shot, I am told, at the derailment at G——." "No, he is not dead, Mein Herr," and Meier smiled knowingly. "Well, proceed, Meier," I said, sorry that I had interrupted him.

"We met at midnight near the old Roman aqueduct that you know, and were planning out operations in a new region, when I learnt from one of our best men that Commander Kutner was in the habit of personally accompanying the fortnightly convoy as far as Pont-a-Mousson, towards Metz, and usually spent the interval between the return journey at the village of H——, where his licentious behaviour and barbarous conduct had made his name stink in the nostrils of the cowed people. On further enquiry by Bossuet it was found out that the auberge at which he stopped was owned by a brother of one of our members. Bossuet went personally and arranged a decoy, which appealed to the amorous proclivities of the commander. It was cleverly done, not a mistake made or a point overlooked."

"On receipt of the note to meet 'la femme,' in her own handwriting, secrecy for domestic reasons was enjoined. He had formerly expressed in Prussian fashion his admiration for the hitherto reluctant party. On the night in question Bossuet, garbed in feminine habiliments, kept the appointment. My father was avenged!"

"Was there no enquiry made, Meier; no shot heard, no witness found?" "No shot was fired, the country was hunted by Uhlans, but to no purpose; he never returned."

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The day before leaving Metz for England I had occasion to visit Meier's house in Sablon, which lay at the bottom of a garden of what had once been a popular rustic restaurant in the palmy days before the war, but now disused and neglected. I found him busily polishing up three French chassepöts (Army rifles) that he had obtained for me by means of a three-hooked drag from the river Seille. He assured me that there were more than a hundred there still, as a company or detachment of French troops had flung them in rather than pile them for the Germans. I felt very grateful, for the pleasure was very genuine on his part. I handed him the testimonial I had promised him, as he intended to leave the province immediately after my departure. With great difficulty I pressed a slight consideration into his hands. When he turned round I saw he was visibly affected, and his voice was somewhat broken as he said, "Herr Patron, I have had a pleasant time with you. The chassepöts are nothing, nor the labour in cleaning. Take anything, anything . . . but the knife." I was handling a fine specimen of a Spahi's dagger knife that I had taken off the wall to look at. "Pardon me, Herr Weatherburn, you leave to-morrow. . . I can trust you, but that is Bossuet's dagger that he avenged my father with."

I had no further desire for the dagger. I never heard again of him, but I feel certain in my own mind that Meier and Bossuet were one and the same person.

When giving in the November RAILWAY MAGAZINE, page 383, a short and partial description, with rough sketch, of the type of boiler supplied by Messrs. Kitson & Co. to the Midland Railway in 1868, I find that I was in error as regards the proper names of the patentees. I am indebted to Mr. Thos. Gillott, of Eastwood, Nottingham, for his very friendly correction, which I feel sure will be of interest to Mr. Anderson and all those who desire to have the correct facts, with further details added. Hence, I have pleasure in giving that portion of his correspondence, and thus place matters right, but in doing so wish to state that the error in the name, though orthographically considerable (Horton instead of Alton), was, phonetically pardonable, as the name Alton (whom I knew by sight only) was generally pronounced with a silent "L." As to the addition "H" and aspirate, that was probably due to misuse and lapse of time. Independently, Mr. Gillott's remarks will be found very interesting in more ways than one; particularly as regards the thick-edged plates, which I distinctly remember, as the first boilers referred to were welded up, blocked and flanged, and connected under my own observation. I must also thank Mr. Gillott for his remarks on the strength and nature of welds, in which we are, happily, of the same opinion. Mr. Gillott writes:—

> "The Horton and Kirtley Boiler, 1868, is not fully described, and no reference is made to the thick-edged plates. The foreman in the boiler shop at Derby at the end of Mr. Matthew Kirtley's career was George *Alton* (not *Horton*), and I knew him very well. I heard him tell the late Robert Russell (foreman at Mr. James Eastwood's works, where I was apprenticed and served 1861-8) that the idea of the thick-edged plates was his, although the patent was 'Alton and Fernie's.' These plates were rolled by Hird, Dawson & Hardy (Low Moor), and were thicker at the edges, from 7-16ths to ½ in., to allow for flanging to the smoke-box tube plate and to compensate for the loss of section by the circular rivet holes; the longitudinal seams were welded (as you state). Mr. Fernie was Works Manager at Derby, and left to join Taylor Bros. & Co., Leeds. Mr. William Kirtley (nephew to Mr. Matthew Kirtley) succeeded him, and read a paper before the Institution of Mechanical Engineers in 1866 describing these boilers and their manufacture. When I was appointed Engineer to the Farnley Iron Co. (1871–1884) I learnt from the Low Moor people the serious trouble and expense they had in manufacturing these plates, and it was no wonder that their use was not extended.
>
> "There are other remarks which I might make respecting the Midland work at this period, but they would be outside the scope of your articles; but I venture to express the hope that you have not ceased writing, and, strange to say, I found in one of my old note-books the piece-work prices paid by Kitson's to the workmen on the Midland goods engines."

A second letter, conveying a similar correction, came four days later (November 6th) from my old friend, Mr. A. Whitaker, late of the Somerset and Dorset Joint Railway, whose memory for names, dates, events, etc., I have had to acknowledge with pleasure in former issues of the RAILWAY MAGAZINE. I take the liberty of giving an extract in order to show how corroborative the two letters are in every essential particular. Mr. Whitaker writes as follows:—

> "I want to thank you personally for the excellent series of articles which you have written in the RAILWAY MAGAZINE. I have greatly enjoyed reading them, and especially so as it was my good fortune to know personally many of the people mentioned therein. May I be permitted to point out one or two little inaccuracies in this month's magazine as to the Midland type of welded boilers: These were brought out by George Alton (not 'Horton') and John Fernie; the patent which was taken out in, I think, 1859,

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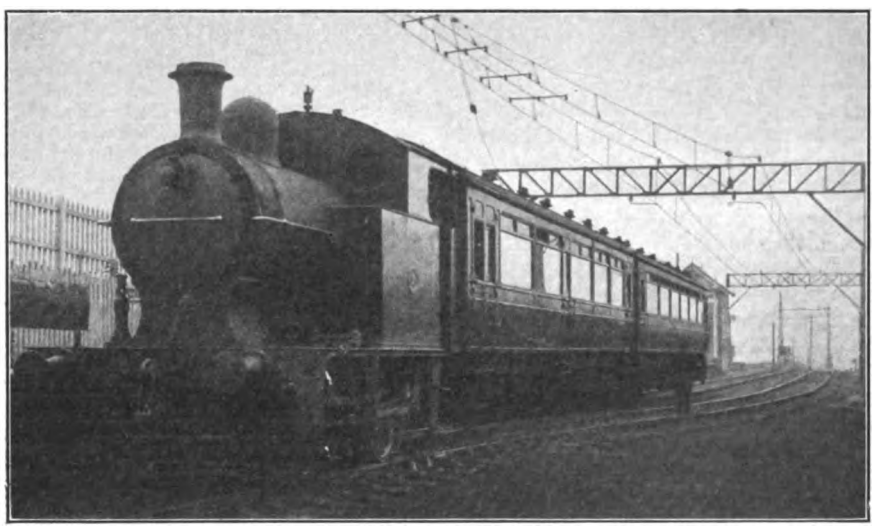
was known as 'Alton and Fernie's.' The former was foreman boiler maker at Derby and the latter was Works Manager from 1856 to 1864, when he was succeeded by Mr. William Kirtley—who is still living in London. I have some old photographs of these boilers showing the thickened edge flanged plate, and these photographs were certainly taken about 1859. Mr. Kirtley read a paper on the subject before the Mechanical Engineers in 1866. The boilers were immensely strong, but I believe very expensive, owing principally to the difficulty of welding the barrel plates; in the later boilers of this type a hoop was shrunk on the centre of each section of the barrel, and there used to be a good deal of discussion as to the necessity of this; the general opinion was that the boilers were amply strong enough without the hoop, and it only added needless weight. The last boiler of this type that I saw was on the Somerset and Dorset at Highbridge; it was used to run one of the stationary engines, and we scrapped it about 20 years ago."

ELECTRIFICATION OF THE BURY—HOLCOMBE BROOK SECTION: LANCASHIRE & YORKSHIRE RAILWAY.



Photo] [*A. Couville.*

LANCASHIRE AND YORKSHIRE RAILWAY.

Rail motor car at Holcombe Brook, showing overhead wires for high tension d.c. equipment now in operation between Bury and Holcombe Brook.

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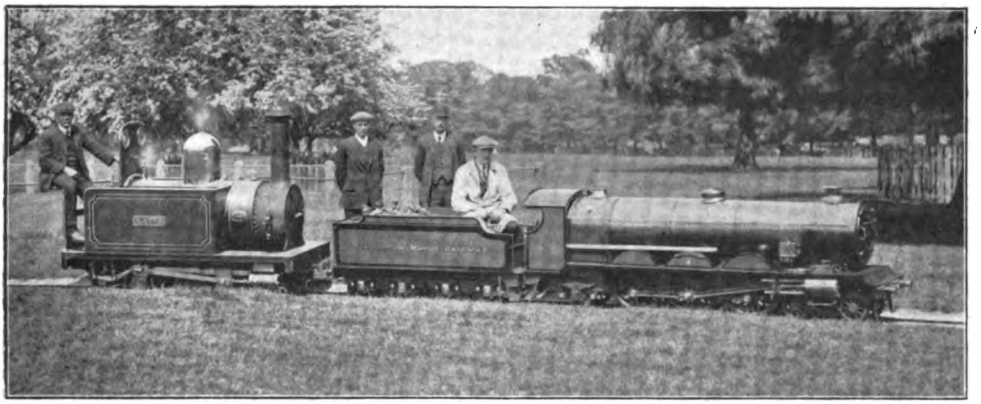

Photo] [*Chidley, Chester.*

THE *John Anthony* AT EATON HALL, COMPARED WITH THE DUKE OF WESTMINSTER'S ENGINE *Katie*.
Mr. Howey is on the "footplate."

A Remarkable Miniature Locomotive.

4-6-2 SUPERHEATER EXPRESS ENGINE "JOHN ANTHONY," STAUGHTON MANOR RAILWAY.

By "VOYAGEUR."

THE number of "Pacific" type express locomotives running on the railways of the British Isles must now be multiplied by two. There is an addition to the family, of which the famous *Great Bear* of the Great Western Railway was up till the present the only representative, in the shape of the "cub" *John Anthony*, which has recently left the Northampton shops of Messrs. Bassett-Lowke, Ltd. Were the miniature engine proportioned out to the full size of its "parent," it would unquestionably be the biggest and most powerful express engine on British metals, but it is, perhaps, more remarkable still to find an engine of such dimensions running on a gauge of only 15 in. The *John Anthony* has been built to the order of Mr. J. E. P. Howey, of Staughton Manor, Hunts., for the purpose of working a miniature railway very similar in character to that owned by Sir Robert Walker, of Sand Hutton, Yorks., whose line was fully described in the March, 1914, issue of the RAILWAY MAGAZINE.

The new 4–6–2 engine is the logical development of the various "Atlantic" type locomotives that the makers have been building for the 15 in. gauge since 1905. In that year the original *Little Giant* was built for the Blackpool Miniature Railway, and this was followed by similar engines for the well-known lines at Rhyl, Southport, Halifax, Sutton Coldfield, and in the exhibition grounds at Shepherd's Bush, Geneva, Nancy, etc. All these engines were built on a general scale of 3 in. to the foot, and were similar in external appearance, save that the later editions were provided with a bogie tender in place of one on six wheels. In 1913 the "Sanspareil," or 30 class, was introduced, the first engine of this type—also of the 4–4–2 wheel arrangement—being the *Synolda*, of Sir Robert Walker's Sand Hutton Railway, already mentioned. A second and similar locomotive is at work at the Christiania Exhibition of the present year. In these locomotives an increased scale was employed in designing the boiler, without at all impairing the external lines of the engine, in order to afford additional steaming capacity. Now we have what might reasonably be called Messrs. Bassett-Lowke's *magnum opus*, in the form of the 4–6–2 engine *John Anthony*, the first "Pacific" ever built for the 15 in. gauge, and a machine of exceptionally handsome external lines. This is known as the "Gigantic," or 60 class.

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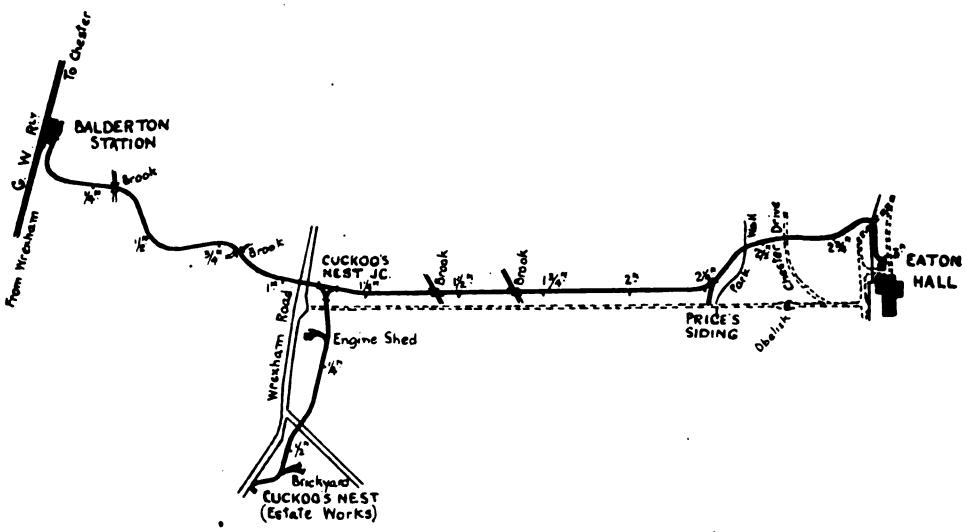
A comparison of the dimensions of these three types is interesting, as affording some idea of the "power progression":—

	"Little Giant."	"Sanspareil."	"Gigantic."
Cylinders, diameter	3 9-16 in.	4⅛ in.	4⅜ in.
,, stroke	6 in.	6 in.	6½ in.
Driving wheels, diameter	18 in.	20 in.	20 in.
Diameter of boiler barrel	17½ in.	19 in.	19½ in.
No. of fire-tubes	25	41	41
Total heating surface	5,270 sq. in.	11,000 sq. in.	13,080 sq. in.
Grate area	204 sq. in.	300 sq. in.	364 sq. in.
Working pressure	125 lb.	130 lb.	150 lb.
Nominal tractive effort	530 lb.	665 lb.	970 lb.
Engine and tender:			
Length over all	14 ft. 1½ in.	15 ft. 9 in.	18 ft. 2 in.
Weight in working order	1 ton 9 cwt.	2 tons 5 cwt.	3 tons
Capacity of tender:			
Coal	56 lbs.	112 lbs.	140 lbs.
Water	40 gals.	50 gals.	68 gals.

The construction of the *John Anthony* is of the most substantial character. Frames are cut from 5-16 in. mild steel plate, and the boiler is also built wholly of steel. Mr. Howey's engine is at present working at a pressure of only 125 lb. per sq. in., although, as will be seen, the boiler is designed for a pressure of 150 lb. per sq. in. It is fed by means of two automatic injectors. An ingenious superheater of gridiron form is provided in the smokebox, and this is supplemented by forced lubrication for the cylinders, in accordance with "full-size" practice. A vacuum brake is provided on the engine, and a screw brake on the tender. In order that the engine may safely traverse curves of a minimum radius of about 130 ft., the trailing axle is fitted with radial axle-boxes, while in addition the tyres of the driving or central pair of coupling wheels are reduced in thickness, to allow of greater side-play. The nominal tractive effort of the *John Anthony* is, as will be seen, almost double that of the original *Little Giant*, and the makers claim that this remarkable machine practically represents finality, so far as the 15 in. gauge or ¼ full-size scale are concerned.

By the courtesy of the Duke of Westminster, some speed and load trials of the new "Pacific" type engine have recently been conducted on the Eaton Hall Railway, which connects Eaton Hall with the Great Western Railway at Balderton, near Chester. On account of its length, which will be seen on the annexed plan to total 3 miles, the "main line" of the Eaton Hall Railway is the most suitable stretch of 15 in. gauge line available for testing purposes, the only drawback being the compulsory stop at the Wrexham Road level crossing, near the 1-mile post. Consequently the majority of the tests were conducted between the 1¼ and 2¾ mile-posts,



SKETCH MAP OF THE EATON HALL RAILWAY.

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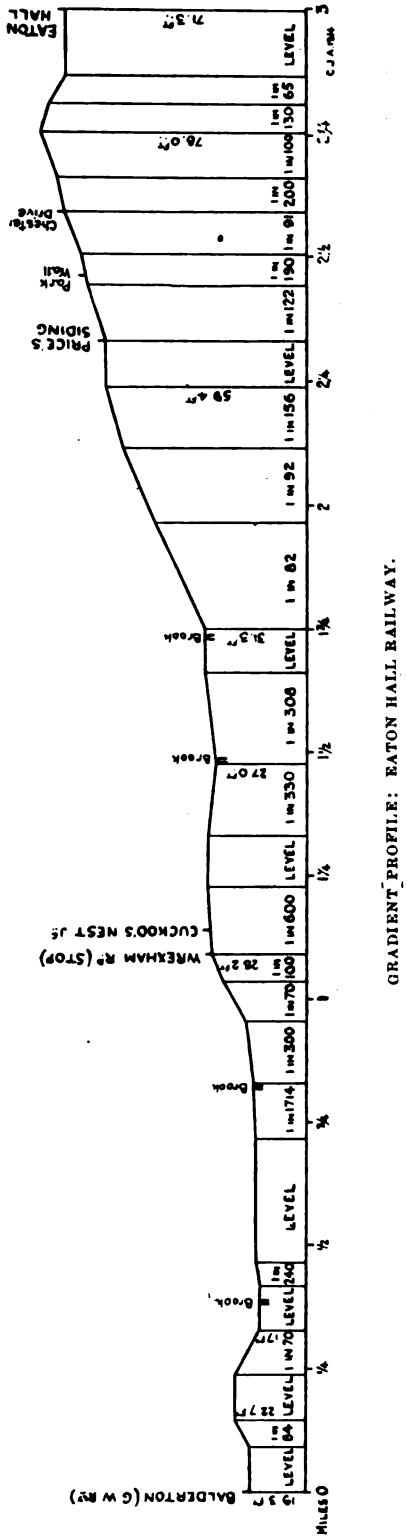

GRADIENT PROFILE: EATON HALL RAILWAY.

this part of the line being nearly straight throughout, while the absence of any sharp curves rendered the highest speeds quite safe almost throughout. Moreover the steep ascent between the 1¾ and 2¾ mile-posts furnished an extremely severe test of the engine's tractive capacity. All the test runs, therefore, were made against the grade. The test loads were composed of wagons loaded with coal, and a bogie brake-van.

The times on the two principal test runs are tabulated herewith :—

No. of wagons (with van)	4	9
No. of axles	12	22
Total weight behind tender	5 tons 8 cwt.	10 tons 9 cwt.
Mile-post 1¼ .. dep.	0.00	0.00
,, 1½ .. pass	1.09	1.27
,, 1¾ .. ,,	1.47	2.08
,, 2 .. ,,	2.29	2.55
,, 2¼ .. ,,	3.14	4.09
,, 2½ .. ,,	4.06	5.10
,, 2¾ .. arr.	5.12	6.23

On the first run the average speed between posts 1½ and 1¾ was 23·7 miles per hour, while the steepest part of the bank—between posts 1¾ and 2¼, mostly up at 1 in 82 and 92—was ascended at an average as high as 20·7 miles per hour. The speed was eased slightly round the curves at Price's Siding and the Park Wall, but despite this the start to stop journey of 1½ miles was completed in 5 min. 12 sec., average 17·3 miles per hour. On the second trip, with the load nearly doubled, the maximum sustained speed between posts 1½ and 1¾ was still above 20 miles per hour—21·9 to be exact—but the average uphill speed from post 1¾ to post 2¼ dropped to a fraction under 15 miles per hour. Still, with a smart finish to the run, the journey was completed in 6 min. 23 sec. —an end-to-end average of 14·1 miles per hour. On both these runs the engine was blowing off furiously; on the first the start only was made in full forward gear, the remainder of the journey being accomplished on the first notch, while on the second trip full forward gear was used both on starting and up the "bank." It is worthy of note that on the first run the fire was not touched throughout the journey, whereas on the second it received attention at one or two points *en route*. The fuel employed was the best Welsh steam coal, broken small.

The heaviest load that the *John Anthony* was able to start without assistance was one

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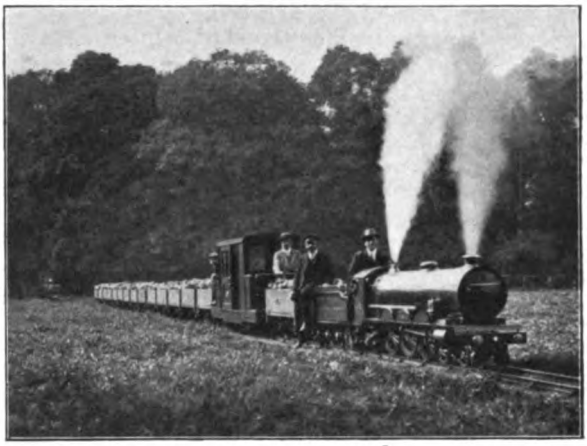

STARTING WITH THE MAXIMUM TEST LOAD.
The driver is Mr. Cecil J. Allen.

of 15 wagons and the brake, totalling 34 axles, or 16 tons 14 cwt. behind the tender. The locomotive moved this load with ease maintaining an average speed of 13·8 miles per hour over the slightly rising grade between mile-posts 1½ and 1¾. The heaviest load taken up the 1 in 82 gradient was one of approximately 15 tons, as against the maximum of 5 tons hauled up the same "bank" by *Little Giant* on her tests in 1905. Moreover, the speed of the latter fell to 6·3 miles per hour on that occasion, whereas the *John Anthony* hauled 5½ tons up the same grade at a minimum speed of 21·4 miles per hour. As an independent test a "flying" time was taken between posts 1¼ and 2¾; the *John Anthony* covered this distance in 5 min. 39 sec. with a load of 9 tons behind the tender, whereas the time of *Little Giant* in 1905 with only 5 tons was 10 min. 34 sec. for the same journey. The enormous increment of power embodied in the 4–6–2 type, as compared with the 4–4–2, is thus apparent.

On the basis of load some interesting comparisons might be made. The total weight in working order of the only other British "Pacific" locomotive, with bogie tender—the Great Western *Great Bear*—is 143 tons; the weight of the *John Anthony* and tender is 3 tons. Proportioning the train loads to the weight of the engine, the equivalent load in the case of the first tabulated run works out at 305 tons, and in that of the second to 500 tons. The equivalent of 15 tons—the maximum load that the new engine worked up the 1 in 82 incline—is no less than 715 tons on this basis, while that of 16 tons 14 cwt., the maximum started on the level by the *John Anthony*, gives the prodigious figure of 795 tons! In its commercial aspect, also, the increased load hauled by the 4–6–2 engine has no small importance.

For a speed test the brake-van and three passengers only were taken, weighing together 1 ton 9 cwt., and with this light load the ¼-mile between mile-posts 1½ and 1¾ was covered in 27·8 sec., at an average speed of no less than 32·4 miles per hour. With the engine running light this figure was increased to the tremendous rate—for the 15 in. gauge—of 34·7 miles per hour, over the same ¼-mile. Even with a reduced working pressure of only 80 lbs. per sq. in. the engine easily maintained a speed of 31·0 miles per hour. The corresponding test in 1905 of *Little Giant* was made *down* the steep "bank," when a maximum speed of 26·4 miles per hour was recorded, but it was deemed inadvisable to test the new engine in this way, or it is quite probable that a speed of 40 miles per hour might have been touched. In any case, however, the speed of the revolving and reciprocating parts of the locomotive, whose 20 in. driving wheels have a diameter equivalent to one of 6 ft. 8 in. in the prototype, was four times as great as those of a full-size locomotive at the same speed. Consequently a similar speed of the moving parts in the case of the *Great Bear*, with 6 ft. 8½ in. driving wheels, would yield a maximum rate on the level of no less than 139 miles per hour! Thus the speed and tractive capacity of the *John Anthony* has exceeded all anticipations, and its designer and builders must be congratulated on the production of so notable a triumph of model engineering.

ANOTHER VIEW OF THE *John Anthony*.

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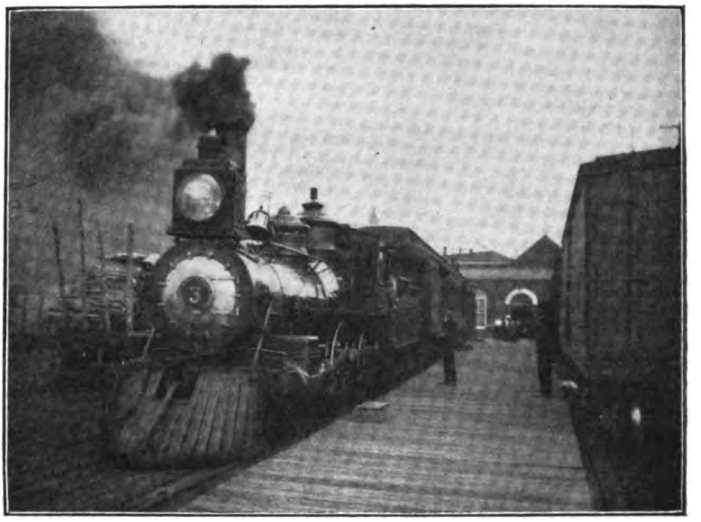
The Esquimalt and Nanaimo Railway.

"The Island Railway of Vancouver."



"NO. 4" READY TO LEAVE VICTORIA.

WITH its termini on the shores of Juan de Fuca Strait and of the Strait of Georgia, the Esquimalt and Nanaimo Railway crosses the southern portion of Vancouver's Island, the direction of the line being almost due north. Vancouver's Island is long and narrow, being about the length of England and the width of Wales. It is very sparsely inhabited, what population there is being almost altogether in the south of the island, where is situated the only large town, Victoria, the southern terminus of the Esquimalt and Nanaimo Railway, accommodating 20,000 to 30,000 inhabitants. Victoria is also the seat of Government of British Columbia and a port of call for vessels from Australia and the Orient. It is in daily communication with the mainland, both Canada and the United States, by steamers plying between it and the cities of Vancouver and Seattle. The northern terminus of the line is at Wellington, five miles beyond Nanaimo and 78 miles from Victoria, the total length of the road being 80 miles.

The line takes its name from Esquimalt and from Nanaimo, which are situated respectively four miles and five miles from the southern and northern termini. Both are places of importance, Esquimalt (pronounced locally "Skimalt") being the Gibraltar of the Pacific, as also the coaling station and headquarters of the British Fleet in the Pacific Ocean. Nanaimo, a town of about 5,000 inhabitants, has in its immediate vicinity very valuable coal mines, and, no doubt, were trouble in which our country was concerned to break out in the East, Esquimalt and Nanaimo and the railroad connecting them would become of the first importance to the British fleet. Between Nanaimo and the mainland of Canada the company maintains a line of steamers, the s.s. *Joan* leaving that place daily at 7 a.m. for the city of Vancouver, and returning thence after the arrival of the Canadian Pacific Company's transcontinental express, No. 1. The s.s. *City of Nanaimo* coasts from Victoria along the south east of the island to Nanaimo and (connecting there with the steamer to the mainland) thence to Comox, 60 miles further north.

There are no fewer than 32 stations on the line, in addition to the termini at each end. But 19 are "flag" stations, where trains only stop when required to set down or take up passengers. The chief freight carried by the line comprises coal, ore, wood, furniture, groceries of all sorts, wines, liquors, etc. There are passenger trains in each direction daily, also one freight train. The freight trains, however, do not run on Sundays.

Passenger trains leave Wellington at 1.15 p.m. (Monday, Wednesday and Friday) or 8.10 a.m. (Tuesday, Thursday and Saturday), and at 2.30 p.m.; the departures from Victoria being 9 a.m. and 3.30 p.m. The total distance between Victoria and Wellington is covered in a little under four hours by the best services, being at the moderate

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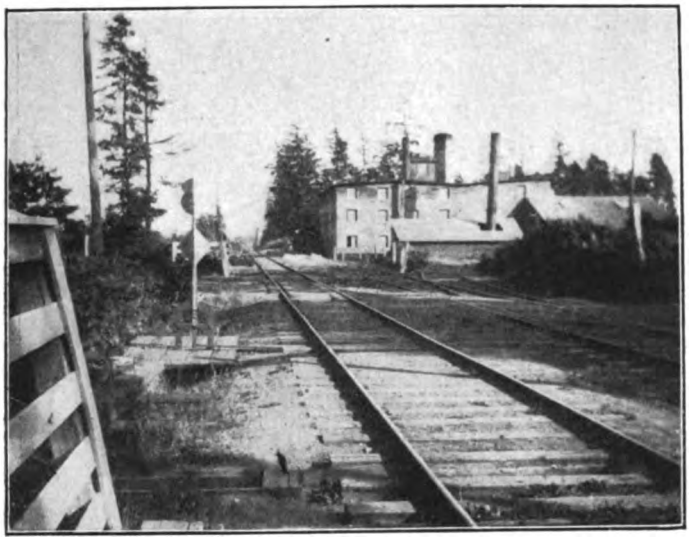
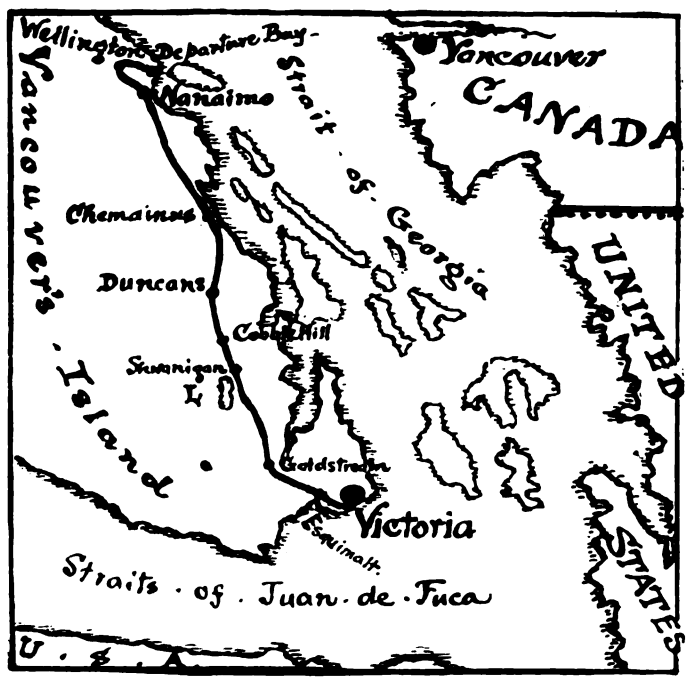


A VIEW ON THE LINE.

speed of 20 miles an hour, including stops. In the summer months this train service is augmented by extra trains, and the line serves several pleasure resorts, including Goldstream, eleven miles from Victoria, noted for its charming sylvian woods, and Shawnigan Lake, famous for its fishing, which is said to be unsurpassed. At Russells' are the company's running sheds, shops, and yards, this place being about a mile-and-a-half out of Victoria.

Rolling stock comprises 8 engines, ranging from 40 to 69 tons weight; 4 parlor cars, 13 first-class cars, 11 second-class cars, 2 observation cars, 3 mail and express cars, 2 mail and baggage cars, 3 baggage and express cars, 2 baggage cars, 13 box cars, 1 stock car, 197 flat cars and 25 coal cars. There are also 26 ballast trucks, 12 vans, 4 tool vans, 1 boarding van, 1 steam shovel, 1 steam hoist, 1 snow plough, a flanger and a boarding van, used for the service of the line. Engines and coaches are of the American type, and the cars are mounted on four-wheel bogie trucks. Engine No. 4 (shown on page 63, at the terminus at Victoria) has the following measurements:—Gauge, 4 ft. 8½ in.; cylinders, 17 in. diameter, 24 in. stroke; driving wheel, 57 in. diameter; driving wheel base, 21 ft. 5 in.; weight on drivers, 52,000 lbs. total weight, 82,000 lbs. (slightly under 40 tons), boiler, 188 tubes 2 in. diameter and 12 ft. long; weight of tender, empty; 45,000 lbs.; capacity of tank, 2,750 galls. This locomotive burns bituminous coal. More modern engines are of suitable standard classes employed by the Canadian Pacific Railway, and are similar to No. 2470 illustrated, known as class D–4. These are the largest in use on the line.

The line is well laid, of the standard gauge: the weight of the rail used is 50, 54, and 60 lbs. Many of them were English-made rails (Cammell steel), of the flange pattern, the "double-headed" rail never being met with in North America. Bridges are of wood, truss and combination, and the steepest gradient on the road is 1·5 per cent., and the sharpest curve 10 degrees.



SKETCH MAP OF THE ESQUIMALT AND NANAIMO RAILWAY.

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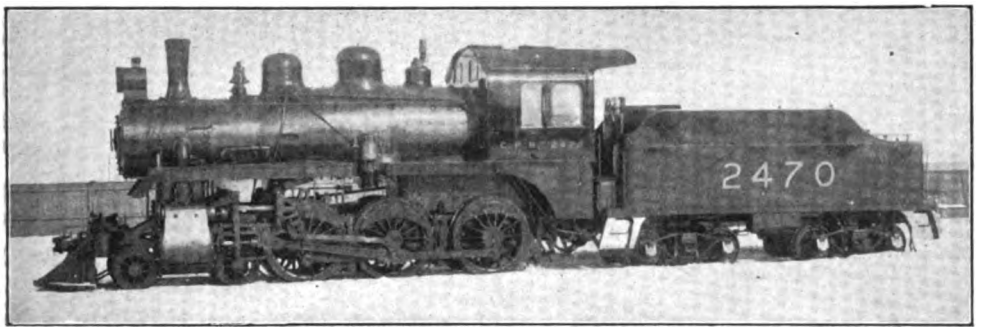
At " grade " crossings cattle guards are laid on each side, consisting of wooden " bars " parallel to the rails about 2 ft. apart and 3 ft. deep. The object of this arrangement is to prevent cattle wandering on to the railroad, which is fenced between the crossings. Such an arrangement is generally unnecessary in England, where substantial gates are usually provided. though in remote districts they are sometimes employed at non-attended crossings. But gates are expensive to erect and maintain, while level crossings are very numerous in Canada and America. There the overbridge is very seldom met with, and the method of opening or closing a level crossing is merely the raising and lowering of an " arm " of wood across the public road.

The building of the Esquimalt and Nanaimo Railway was begun in 1884, and completed two years later. It cost about two-and-a-half million dollars (£500,000), or a little over £6,000 a mile. Between this line and the White Pass and Yukon Railroad in Alaska there are some points of resemblance, each having much the same length of road, equipment, and train service. The latter road, however, presented more severe difficulties in construction, and cost three times as much. It will be remembered, no doubt, by some readers of the RAILWAY MAGAZINE that when the gunboat *Flora* grounded on Denman's Island, the British Admiral, in order to reach the scene with the least possible delay, travelled by special train over the Esquimalt and Nanaimo Railway. In the future, when Canada, with its great resources, has been fully developed and well populated, Vancouver's Island, with its beautifully mild climate, will possibly boast of a network of railways with the Esquimalt and Nanaimo as its pioneer line.



STANDARD 4-6-0 TYPE OF ENGINE (CLASS D-4, VAUGHAN-HORSEY SUPERHEATER) NOW USED ON THE ESQUIMALT AND NANAIMO RAILWAY.

Cylinders	10 in. × 24 in.	Heating surface—Tubes	925 sq. ft.
Coupled wheels	5 ft. 2 in.	,, ,, firebox	143 sq. ft.
Coupled wheelbase	11 ft. 10 in.	,, ,, superheater	173 sq. ft.
Engine wheelbase	22 ft. 1 in.	,, ,, total	1,241 sq. ft.
Total wheelbase	49 ft. 7¾ in.	Grate area	28 sq. ft.
Adhesion weight	50¾ tons.	Steam pressure	180 lbs. per sq. in.
Engine weight	62 tons.	Total weight, engine and tender	107 tons.

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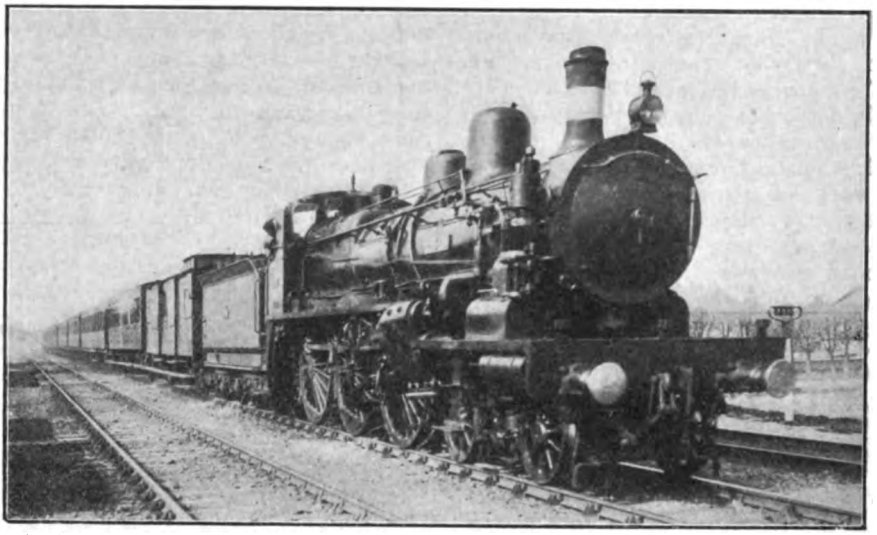

Photo] [W. H. C. Kelland.

OUEST-ÈTAT RAILWAY, FRANCE.
4-6-0 LOCOMOTIVE ON EXPRESS TRAIN NEAR POISSY.
White bands on chimney indicate that engine is fitted with cab signalling apparatus.

British and Continental Locomotive Constructional Practice.

By F. IAN G. RAWLINS.

ALTHOUGH wheel arrangement is a more or less popular method of comparing locomotive practice, it also affords a most convenient means of dealing with the subject, especially as it shows very clearly the different conditions obtaining here and abroad. In this connection the first determining factor presenting itself to the locomotive engineer is the weight permissible per axle; this in its turn is the primary consideration with regard to the all-important subject of adhesion.

It is a well-known fact that British permanent way is amongst the best in the world—if not *the* best—and in the majority of cases our bridges and underline work may be said to be "Well and truly laid." This cannot always be said in reference to Europe as a whole. This factor limits more severely the point load allowed, with the result that to obtain the same amount of "weight available for adhesion," a correspondingly greater number of axles require to be coupled. Taking an instance of this, mention might be made of the general use of eight and ten coupled locomotives abroad, the former sometimes for passenger service. This is due to the smaller bearing qualities of the roads, and eight and ten coupled engines are needed to do the work which might here be accomplished by locomotives with six or eight coupled wheels.

Grate area may next be dealt with, as the arrangement of wheels has a direct effect upon the size of grate which can be utilised. Abroad grate area is usually large as compared with the average figures to be found in these islands. One reason that can be advanced in support of this difference is that the coal generally supplied on the Continent is distinctly inferior to that provided at home, with the result that more fuel is required to generate a given amount of heat. Also the over-rapid consumption of coal is known to have the effect of giving out large quantities of smoke—an objectionable feature to be avoided at all costs.

The way in which the arrangement of wheels affects this question is to be found in the fact that the more general adoption of an uncoupled trailing axle gives the necessary space in which to build an enlarged grate, and incidentally one that is easy to fire. Examples of this may be found in the 4-6-2 and 4-6-4 types existing in France, and the 4-6-2 and 2-6-2 types respectively

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in Spain and Italy. Some other countries have been content to adhere to types provided with a trailing coupled axle, and such may be taken as another proof—hardly needed perhaps—of the lack of finality in locomotive design all the world over.

This again is one of the instances where "conditions alter cases," and certainly the work performed in the main on the Continent is sufficient testimony to the wisdom of providing ample fire grates.

Reference to compounding opens up a controversy of such magnitude that only a brief statement of fact can be given. In this connection readers may be reminded of a comment made by the late Mr. Charles Rous-Marten in the columns of the RAILWAY MAGAZINE in 1906. Anent the "de Glehn" compounds on the Great Western Railway, when they were novelties in this country, he quoted a passage from an address by M. de Glehn, the underlying argument of which was:

"Is the complication necessitated by compounding justified?"

In France the answer was, and is, "Yes," and although some lines, notably the Chemin de fer de Paris, Lyon, Méditerranée, have built four cylinder simple engines to try conclusions with corresponding compounds, the general outcome is the same, *i.e.*, in favour of compounding, though now in association with superheating. The Paris, Lyons, Mediterranean have even gone so far recently as to convert some of their simple "Pacifics" to compounds on the ground of greater fuel economy and general efficiency.

A point that must not be lost sight of is that wherever and whenever the compound system has achieved substantial success, it has almost always been in conjunction with high working pressures, usually over 200 lbs. per square inch and in one isolated instance 256 lbs.

Although the coupling of all the driving axles is of great moment, as readers are fully aware, this was not the case in the late Mr. F. W. Webb's earlier compounds, built at Crewe, nor in the original "Nord" locomotives constructed some 28 years ago on the de Glehn system.

Super-heating and working pressures may be bracketted together, as they are so interdependent that separate consideration of each would fail to bring out the salient points with regard to the differences existing in Great Britain and on the Continent. In the first place it must be admitted that the perfection of superheating has not been accomplished in these islands, though in the early days of railways our locomotive engineers were by no means idle in attacking the elementary problems connected with raising the temperature of steam by waste gases. In all probability the reason for the cessation of activity in this direction was that no real need for increased efficiency had arisen; and also the advent of compounding tended to direct the attention of enthusiasts into other channels.

The partial recrudescence of compounding in these Islands about seven years ago, was not attended with a corresponding superheater "renaissance," but abroad the two questions have been attacked with increasing energy, though it is only with super-heating that we are now concerned.

Anyone who has read M. Edouard Sauvage's "Lectures on Super-heating on Continental Locomotives," cannnot fail to be struck with the discussion that took place on the subject of super-heating, in which many notable engineers from different parts of Europe took part. All were agreed that a considerable economy in fuel and water was brought about by the introduction of super-heating apparatus, in conjunction with either compound or single-expansion cylinders, though in the former case there was divided opinion as to whether one stage of super-heat was enough, or, whether an arrangement was desirable by which the steam is super-heated once before entering the high-pressure cylinders, and again before doing its work in the low-pressure cylinders.

Turning now to a discussion of working pressures, a very great difference exists, in that foreign locomotives are nearly always pressed to higher figures than those in use here. This is to a great extent explained by the use of compounds which as before suggested are of necessity worked at high pressures, as otherwise their efficiency tends to disappear. Working pressures of 160 to 180 lbs. per square inch are quite the rule here when high super-heat is in use; whereas on the Continent 227 lbs., even in conjunction with super-heated steam, is not an exceptional figure, thus proving with some weight the necessity for maintaining high pressures when compound working is in vogue.

One is tempted to doubt how much economy—which our Continental friends love dearly—results from this procedure, as surely the reduction of working pressure is a potent source of minimising maintenance and prime costs, which this practice seems inclined to frustrate.

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Underground Electric] [*Railways of London, Ltd.*

VILLIERS STREET FRONTAGE, CHARING CROSS (UNDERGROUND) STATION.

District Railway Improvements.

DURING recent years the changes effected on the Metropolitan District Railway have been so considerable, that one familiar with the conditions of seven or eight years ago can hardly recognise the material which did duty in the pre-electric days. Most of the developments have been dealt with in these pages, and in the RAILWAY MAGAZINE for December, 1913, a comprehensive article appeared on this subject. Particulars were then given, with drawings, of the new station buildings in process of erection at Charing Cross (Underground station). These are now completed, and two photographs are reproduced.

The old buildings, dating from 1870, have been demolished, and in place of an all-over roof, the District station is now covered by the South Eastern and Chatham Railway bridge, and by the new station buildings on road-level, while usual awnings are being erected to shelter the small portions of the platforms which are otherwise open to the sky.

Above ground a really beautiful booking hall is now available, extending right across the station from the Embankment to Villiers Street. The two frontages are of white Portland stone, artistically designed, with flanking columns and characteristic District features. The hall forms a wide arcade, with a series of booking windows on one side, the cabinet work—of itself this is worthy of special note from the æsthetic point of view—being further embellished by a series of artistic pictorial panels utilising poster illustrations, while on the other side access to the platforms and to the "tube" stations below, is given by means of iron gates and stairways. This arcade is provided with a glazed dome in the centre, while the tesselated pavement and the stonework are in harmony with the general scheme of decoration.

Although necessarily only a single storey erection the station buildings constitute an artistic addition to the frontage along the Embankment, and harmonise with the London County Council offices adjacent. Mr. H. W. Ford, for many years resident architect to the Metropolitan District Railway Company, and who has carried out most of the reconstruction involved by electrification is the architect.

At Blackfriars station also important improvements have been carried out, but in this case the alterations are of a structural character. At the busiest part of the westbound platform valuable space was taken up by the only staircase that could be used, leaving little more than 6 ft. of platform width available. By taking down a wall at the back of the platform it became possible to transfer the stairs right off this area, giving the whole width available for passengers. Another staircase has also been provided from the bridge. Therefore, in lieu of one narrow staircase and a 6 ft. width of platform, there are now two staircases and twice as much width of platform space. The bookstall and tobacco stall have been removed from space which they occupied on the platform to better sites which are off but contiguous thereto.

An interesting feature of Blackfriars station, District Railway, in addition to the structural changes above referred to, is the fact that the ticket collectors are now provided with cash registers for dealing with excess fares, the machines being provided by the National Cash Register Co., Ltd. Besides the two machines at Blackfriars, there are also two at the Mansion House, and one each at Charing Cross, Sloane Square, Chiswick Park, Walham Green, and Ealing Broadway.

Continuing the policy of improving traffic facilities wherever there is justification therefor, and to enable Mr. W. E. Blake, Superintendent of the Line, Metropolitan District Railway, to accelerate underground traffic still further than

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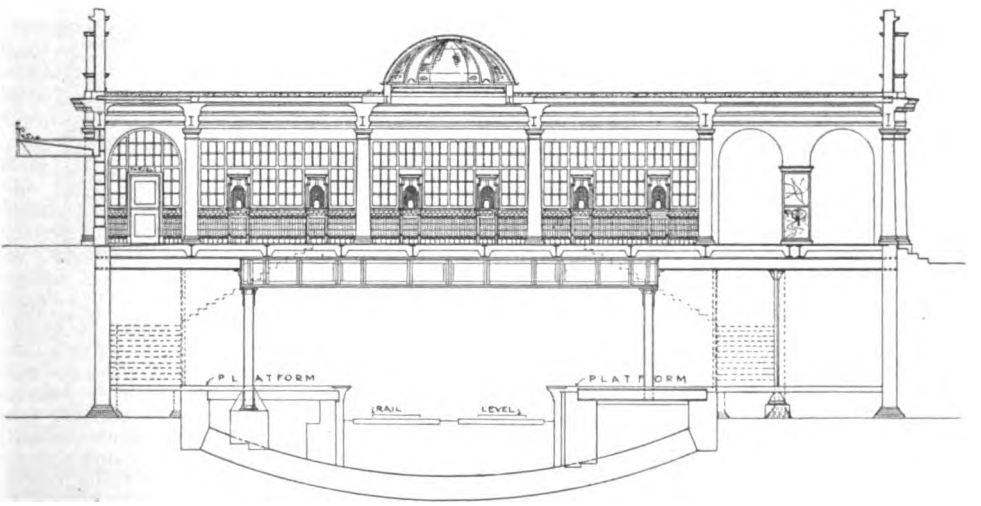
Underground Electric] [*Railways of London, Ltd.*

THE NEW BOOKING HALL AT CHARING CROSS (UNDERGROUND) STATION.
FROM THE EMBANKMENT ENTRANCE.

he has done in the past, important alterations have been made at Whitechapel station. The present station there includes two island platforms, connected by an overhead foot-bridge with a passage leading to a booking hall now used in common with the East London Railway. The latter passes nearly at right angles, and whereas the old District terminal station did not require to pass over it, the construction of the Whitechapel and Bow Railway entailed raising rail level so as to pass by means of girder bridges over the lower station, thence descending steeply to the tunnel leading to Stepney Green.

As thus reconstructed only one of the down lines crossed the East London station, the wall road, until recently used for terminating Metropolitan and Great Western Joint trains during the period when the connection with the East London Railway between St. Mary's and Shadwell was not in use, terminating in a dead end. East of the crossing there was a siding road



TRANSVERSE VIEW OF THE NEW BUILDINGS AT CHARING CROSS (UNDERGROUND) STATION.

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almost in alignment with the wall road in the station, but built so as to be virtually level; consequently most of its length was lower than the through main line descending from the bridge over the East London line.

The lay-out thus gave only one through road for east-bound trains with a bay used for terminal purposes, while for up traffic there was, in addition to the through line, a platform loop and a siding road. The down wall road has now been continued over the East London Railway, so as to join up with the low level siding beyond, the latter being raised to agree with the gradient of the through line. In carrying out this work the retaining wall has had to be cut back somewhat, and the East signal cabin removed, all the work being now concentrated in the western cabin, a simple measure seeing that the signalling is McKenzie, Holland and Westinghouse electro-pneumatic connecting with automatic equipment in either direction.

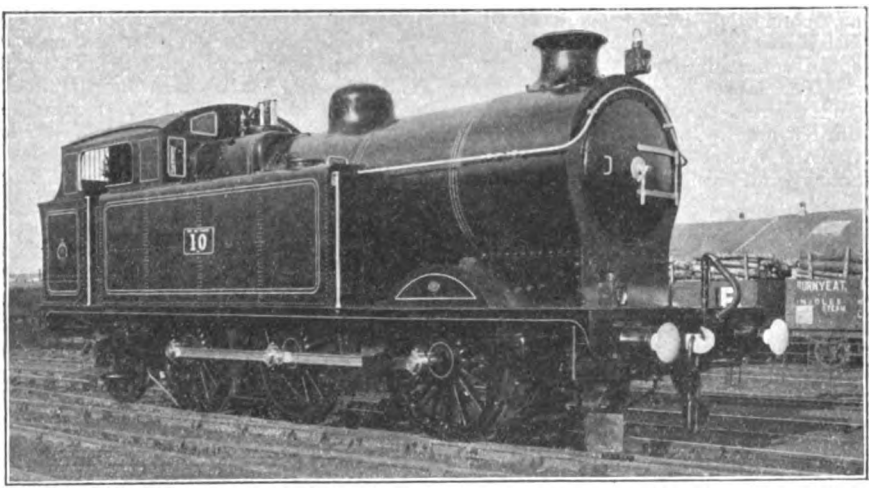
As a result of these changes, there are now loop platform lines in both directions, giving facilities for passing trains if required, as well as assisting in dividing up or adding to trains to suit varying traffic demands. At periods when storage space is required the down loop is more or less used for that purpose, train working being arranged to clear it when it is desired to utilise it as a through loop road.

These alterations were only brought into use on October 1st, and one important traffic development rendered possible thereby relates to the 4.50 p.m. train from Hammersmith to Upminster (Saturdays excepted) and the 1.42 p.m. from Hammersmith on Saturdays. Mr. W. E. Blake supplies a schedule of the work that is done in the new down loop line during a few busy minutes of the evening. This record is interesting, and is probably unequalled for closeness of working on one loop line used also for terminating, although it is working well:—

Train arrives.	Train departs.	Remarks.
p.m.	p.m.	
—	4.51	Stabled train departs.
4.53(down)	4.57 (up)	Has additional vehicles attached.
4.59 ,,	5. 4 ,,	Has additional vehicles attached.
5. 6 ,,	5.10 ,,	Has additional vehicles attached.
5.12 ,,	5.16 ,,	Has additional vehicles attached.
5.18 ,,	5.20 (down)	While this train is standing in No. 1 line, the Upminster fast train passes at 5.19.

NEW 0-6-2 TANK ENGINES: TAFF VALE RAILWAY.

Designed by Mr J. Cameron, Locomotive Superintendent.



THESE engines, built by Messrs. Hawthorn Leslie & Co., Ltd., of Forth Banks Locomotive Works, Newcastle-on-Tyne, are designed for general traffic, working passenger or mineral trains as required, or on shunting duty. They are capable of handling passenger trains at a speed of 45 miles per hour, and mineral trains of fifty or fifty-five loaded wagons at 17-20 miles per hour, on a gradient of 1 in 200. Cylinders are 18½ in. by 26 in.; coupled wheels, 5 ft. 3 in. diam.; heating surface consists of 1,332·66 sq. ft., of which the firebox contributes 121·53 sq. ft. and the tubes 1,211·13 sq. ft.; grate area is 18·5 sq. ft.; steam pressure, 160 lb per sq. in.; tank capacity, 1,708 gallons; bunker capacity, 2½ tons of coal; tractive force at 80 per cent. of working pressure, 18,050 lb.; adhesion weight, 56½ tons; total weight in working order, 69 tons 1 cwt.; coupled wheelbase, 14 ft. 6 in.; total wheelbase, 20 ft. 7 in.; length over buffers, 35 ft. 5¾ in. Fixed wheelbase is short to permit of sharp curves being traversed. The trailing wheels are fitted in radial boxes. The firebox is of Belpaire type. Diameter of boiler barrel is 4 ft. 8⅝ in., and 11 ft. 4¾ in. long between tube-plates. A series of similar engines are being constructed by the North British Locomotive Co., Ltd., on the cancellation of an order previously given to the Hanover Engineering Works.

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PERTINENT PARAGRAPHS

"Northward-Bound."

UNDER this title the frontispiece for this month gives a striking view, from a photograph by F. E. Mackay, illustrating the departure of the famous 2 p.m. Anglo-Scottish express from Euston. As usual, it has two engines, but it may be explained that the ordinary procedure with this train is that the leading engine assists only as far as Willesden Junction, thence taking the "Sunny South Special," brought by a London, Brighton and South Coast locomotive to that station. The engine thus allocated is in this case a "Precursor," No. 811 *Express*, while the train engine, continuing the duties once associated with the famous *Jeanie Deans*, is a new superheater engine of the "Prince of Wales" class, No. 979, *W. M. Thackeray*.

Traffic Developments Due to the War.

AFTER nearly two months with few drastic modifications of normal railway conditions to meet military and naval requirements, the third week in November witnessed important war transportation developments. The Great Eastern Railway issued the following notice: "Owing to Government requirements the train arrangements in various parts of the line may be put out of course on November 16th and 17th. Passengers are, therefore, advised that delays of more or less extent are likely to occur, but every effort will be made to minimise the inconvenience." A similar notice was brought out on Friday, November 13th, and has since been repeated as required, but the days noted above have been the busy ones. The Company gave notice that, in addition to the usual closure of the Victoria Park section, from 7.30 p.m. on Monday until 11 p.m. on Tuesday, the whole of the Norwich-Cromer, Mundesley, Sheringham and West Runton section would be closed to public traffic between 6 a.m. and 6 p.m. on Tuesday, November 17th. From about 6 p.m. on the Monday and all day on the Tuesday the whole of the North London Railway was closed, including Hampstead Junction and Great Northern and London and North Western traffic. All stations were closed during the period, even at Broad Street there being only one gate open to give access to the shops along the forecourt and in the station.

Parliamentary Acknowledgment of Railway Services to the State.

IN moving a vote of a supplementary sum not exceeding £225,000,000 for the purposes of the war, and explaining how the £100,000,000 vote of credit passed in August last had been spent, Mr. Asquith, in the House of Commons remarked that it included "the sum—the not inconsiderable sum—which we had had to expend in order to secure the active control of the railways of the country which was necessary at a time like this." Mr. Walter Long, in approving the vote, said: "The control over the railways has not only worked without a single hitch, but with the most wonderful regard for the convenience of the public at large. It has been, I think, one of the most successful enterprises ever undertaken in this country. We had a variety of systems of railways; we had to make an enormous demand upon them for the conveyance of troops and stores; and we had, if possible, not to interfere unduly with the travelling public. I myself have had occasion to travel about the country from the beginning of the mobilisation orders, and I do not believe that any reasonable person can by any possibility complain of the way in which the Government have utilised their control and provided alike for the needs of the nation and for the convenience of individuals."

A Military Tribute.

ON the departure of the North Lancashire Infantry Brigade, whose duties of guarding the Great Western Railway between Paddington and Bristol, have been taken over by National Reservists, the following letter has been addressed to Viscount Churchill, Chairman of the Great Western Railway Company, by Brigadier General G. S. Hibbert: "On the eve of the departure of my Brigade from the Great Western Railway, on which we have now been on duty for nearly three months, I should like to express to you, on their behalf and my own, our great appreciation of the constant courtesy and assistance we have received at the hands of the officials and employés of the Company of every rank and grade. It may well be that, at times, some of us may have caused extra trouble and labour above and beyond that incurred by the ordinary working of the line, but every such case has been met uncomplainingly by the employés of the Company, with good nature and good sense and an evident desire to avoid any sort of friction. It only remains for me to express our regret for any trouble we have caused, and, through you, to thank every one of the officials and employés of the Company with whom we have been connected for their helpful kindness at all times."

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Railwaymen with the Colours.

LAST month we recorded the Great Western Railway's contribution to the National Forces as 8,109. Our Great Western contemporary gives later figures bringing the total to 8,807, with the following departmental details :—

General Manager's	11
Secretary's	10
Chief Accountant's	24
Solicitor's	4
Passenger	1,388
Goods	1,415
Locomotive	4,031
Engineering	1,233
Signal	296
Electrical	39
Stores	74
Audit	74
Marine and Docks	89
Hotels	105
Rates and Taxes	2
Estate	6
Stationery	6
	8,807

The London and North Western Railway also records increases, and in connection therewith has issued a large poster whereon, as a "Roll of Honour," the following numbers of the Company's men who are serving with His Majesty's Forces, are stated under date of November 20th :—

Goods	3,441
Locomotive	2,425
Carriage and Wagon	1,479
Traffic	1,251
Engineering	1,208
Marine	509
Other Departments	412
Total	10,725

When giving a list last month of the numbers of men contributed by various railways to the National Forces the Cheshire Lines Committee was unfortunately omitted. We have pleasure in stating that over 500 men from the Committee's service are serving with the Colours, and two of them have been killed in action, so that in common with other railway companies the staff of the Joint system are doing their share in the defence of the Empire.

Mr. H. B. McMinn and Mr. J. Grosvenor Hodgkinson, of the Chief Goods Manager's department, Midland Railway, Derby, have been granted commissions as lieutenants in the Royal Engineers Railway Troops. Mr. R. T. McCallum, of the Engineer's department, Midland Railway, eldest son of Mr. P. S. McCallum, the late Estate Agent of the Company, has been gazetted a second lieutenant in the Royal Engineers.

Alexandra (Newport and South Wales) Docks and Railway and the War.

UNDER the able management of Mr. J. H. Vickery the coal traffic of the Docks has kept up fairly well during the War, largely owing to shipments for the British Admiralty and also to meet the French Government requirements. Fresh records of rapid loading have been established, and there have been many cases of vessels arriving and taking their cargoes in exceptionally quick time, as the following instances show :—

	Tons shipped.	Loading time. Hrs.	Mins.
Horden	1,897	7	5
Hyltonia	2,946	12	40
Poldhu	3,709	18	30
Glencoe	3,827	15	35
Cherbury	4,774	19	30
Picton	6,003	30	40
Ellerwater	1,704	4	35
Elvet	1,760	6	40
Inver	1,221	2	35
,,	1,248	3	20

In common with other ports the cargo business has shown a falling off, but the future prospects seem excellent.

The Cunard liner *Ascania*, unable to use her home port owing to troop movements, came to Newport and took about 600 passengers, for whose accommodation special trains ran through from Paddington alongside the vessel. One of the Elder Fyffes steamers was also similarly dealt with. The captured vessel of the Hamburg-American Line, *Belgia*, is still in the Dock, but her cargo has been unloaded and dealt with, a considerable portion of it being in the Company's warehouses. Several Belgian steamers came in before the capture of Antwerp, and are laying up, for which there is ample accommodation in the spacious New Dock.

Railwaymen and Ambulance Work.

ONE important feature in regard to the railwaymen who have joined the colours is the large proportion of them who have passed their examinations in first aid to the injured, after attending classes of the St. John Ambulance Association or in Scotland of the St. Andrew's Ambulance Association. No census has been taken of the numbers thus qualified, but the following list of those holding awards in the staffs of the companies specified indicates how widespread is the movement. There are, of course, duly qualified men who are not members of the brigades.

Alexandra Docks and Railway	331
Caledonian	1,700
Cambrian	1,520
Cheshire Lines Committee	380
Furness	360
Great Central	1,800
Glasgow and South Western	532
Great Northern	1,200
Great Western	6,210
Great North of Scotland	560
Hull and Barnsley	145
Lancashire and Yorkshire	3,500
London and North Western	8,900
London and South Western	2,192
London, Brighton and South Coast	3,920
Metropolitan	450
Midland	9,898

The London and North Western Company's total of 8,900, remarks the *Railway News*,

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represents about 10 per cent. of the staff. The Midland Company's total of 9,898 represents nearly 14 per cent. of the staff. In addition to this number, 523 ambulance men have joined the forces. Valuable assistance has been rendered by the ambulance staff at some of the towns on the system in attending to and transporting to the hospitals wounded soldiers from the front. Of the Caledonian staff a number of men have joined the R.A.M.C. and Home Hospital Reserve, and there are over 500 practising regularly in transport work at different parts of the system, so as to be in readiness if their services are required at home. Of the 532 qualified men of the Glasgow and South Western Railway, over 100 have volunteered for service abroad in a St. Andrew's unit of the R.A.M.C., and also for a Home Hospitals Reserve in Scotland.

French Railways and the War.

IT is inevitable that the work of our own railways in connection with the War should receive most attention, but recently "Eye-Witness" rendered a valuable tribute to the services rendered by the French railways. He points out that "the way in which our troops have been supplied is admittedly one of the features of the campaign. In fact, it is probably not saying too much to state that no soldiers in the field have ever been so well fed as are ours to-day. Full credit for this must be given to the branch of the British Army concerned; but at the same time, it must be recognised that its efforts would have been in vain except for the whole-hearted co-operation and assistance of the French railway authorities. The railway system has worked without a hitch, and in carrying out a complicated transport task which has developed in a direction which could not exactly have been foreseen has proved to what an extent of elastic efficiency the organisation has been brought by preparation and practice in peace manœuvres. Amid all its multifarious duties in supplying the French troops spread over an area of some 350 miles, it has never once failed in the additional duty of acting as a line of communication for the British Army."

The Use of Railways in War.

WRITING in *The Times* a military correspondent comments upon the marked advance in war methods, amounting almost to a revolutionary change, which has resulted from the efficiency of railways and the service which they have rendered to strategical and tactical combinations. He remarks that "it was pretty good for the Russians to have sent 48 trains every 24 hours each way on their main lines at the opening of the war, but in France these figures have been almost tripled at times, and in Germany very great use has similarly been made of railways. Army Corps and even whole Armies have been suddenly entrained and removed hundreds of miles in a night, or at all events in a brief space of time, and have reappeared unexpectedly at some other places." The writer points out that certain special operations carried out by the German and Austrian forces must be attributed largely to a highly developed railway system, and these events are only the precursors of others which will follow before the war ends.

So far, the home railways have not had to deal with transport under actual warfare conditions, but there is every indication that in France and Russia, as also while it was possible in Belgium also, railways have been utilised quite as effectively as have those of Germany and the dual Empire. Indeed, there is little doubt that this war will rank pre-eminently as one where rail and road transport machinery and efficiency have been of paramount importance.

Lord Roberts and Railwaymen.

OUR weekly contemporary, the *Railway News*, directs attention to the fact that although the late Lord Roberts had never been closely associated with the railway side of military operations, he had on several occasions been brought closely into touch with railwaymen and railway affairs. On April 23rd, 1903, Lord Roberts unveiled a tablet in the Great Hall at Euston in memory of London and North Western railwaymen who died in the South African War from wounds or diseases. In the course of his remarks Lord Roberts naturally dealt mainly with the London and North Western Railway contingent, but his praise applied equally to the men who went from other companies. He said that of the 1,760 men of that Company who went to the war no less than 1,093 were Reservists. The memorial was a fitting tribute to the ninety-nine men who had laid down their lives in South Africa. He was acquainted with the excellent work those men had done in South Africa, and knew what use those who knew railway work were to the Army when they first took possession of Bloemfontein and Pretoria. He was surprised and delighted to find what a number responded when he asked for those who understood railway work. If it had not been for the assistance given at that time their difficulties would have been greatly increased.

On the day preceding the public funeral in London, a special train conveyed the body of Lord Roberts from Folkestone to Ascot station, where it arrived at 3 p.m. The train, taken by a South Eastern and Chatham engine, consisted of three carriages, the centre one being a saloon. In this rested the remains, in a plain oak coffin, covered by a Union Jack, upon which was placed Earl Roberts's khaki field service cap. Surrounding the coffin were many beautiful floral tributes. These were removed and laid on the platform. Then the coffin was placed upon a hand bier, and was wheeled direct from the platform to the grounds of Englemere, where members of the household received it. The following day a special train conveyed the coffin to Charing Cross, the engine, provided by the London and South Western Company (No. 772), being draped in purple and black, and bearing the Union Jack in front.

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How Railwaymen assist in other ways.

Railwaymen have also assisted in various other ways, and as typical of many such instances it may be mentioned that at the outset of the pressure, the Clerical Staff of the London and North Western Railway at Rugby informed the Clerk of the Urban District Council that their services could be relied upon to assist in any direction locally, and within a few days, a request was made by the District Recruiting Officer for a number of clerks to attend each evening at the Rugby Drill Hall.

Under date of October 20th, Colonel Mulliner wrote to the District Goods Manager :—

> "Before leaving here to take up my new appointment, I take the opportunity of thanking you for the services of the many members of your staff who gave me such valuable assistance during the rush. It may interest you to know that the number of recruits which were obtained (5,444) for Lord Kitchener's Army is considered a record in all England. Will you kindly convey to them my sincere thanks ?"

In addition may be mentioned the practice adopted on all railways and at nearly every passenger and goods station, of making weekly or periodical collections on behalf of the War Funds.

Miscellaneous War Items.

ALTHOUGH the general impression that the taking over of the railways by the Government enables free travel to the National Forces and other facilities to be granted without any difficulty involves only a partial realisation of the facts, we are glad to note that favourable arrangements to meet the needs of men stationed far from their homes are being made in connection with the Christmas Holidays. It is an admitted grievance that the mere fact that a man is stationed a long distance from his home should involve him in heavy travel expenditure to utilise a brief vacation.

Sir George S. Gibb, Chairman of the Board has been appointed an additional Civilian Member of the Army Council. Sir George Gibb's duties will be the supervision of the Army contracts. It will be remembered that Sir George Gibb was for some years General Manager of the North Eastern Railway, and later became identified with the Underground Electric Railways of London. An illustrated interview with him was published in the RAILWAY MAGAZINE for December, 1897.

During his recent visit to France, His Majesty the King took the opportunity of sending for Captain Carey, of the South Eastern and Chatham Railway steamer *Queen*, which rescued about 2,500 refugees from the *Admiral Ganteaume* in the English Channel on October 26th.

The Lancashire and Yorkshire Railway has accepted from the Parliamentary Recruiting Committee, for exhibition at its stations, a large number of posters dealing with the need for recruits. A very effective display of these bills has been made at Victoria station, Manchester, as shown on this page.

Owing to the war, the annual ball of the salaried staff of the Midland Railway, which is usually held on the first Friday in February, will not take place next year.

Mr. C. F. Wilkins, horse inspector at Derby, Midland Railway, and formerly battery sergeant in the Royal Field Artillery, has been promoted on the field since he rejoined the Colours to the rank of 2nd Lieutenant R.F.A.

Mr. John M. Cooper, eldest son of Mr. David Cooper, the well-known General Manager of the Glasgow and South Western Railway, has received a commission as lieutenant in the 5th Batt. Scottish Rifles (late 1st Lanark).

A STRIKING DISPLAY OF RECRUITING POSTERS AT VICTORIA STATION, MANCHESTER, LANCASHIRE AND YORKSHIRE RAILWAY.

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What the Railway Workshops are Doing.

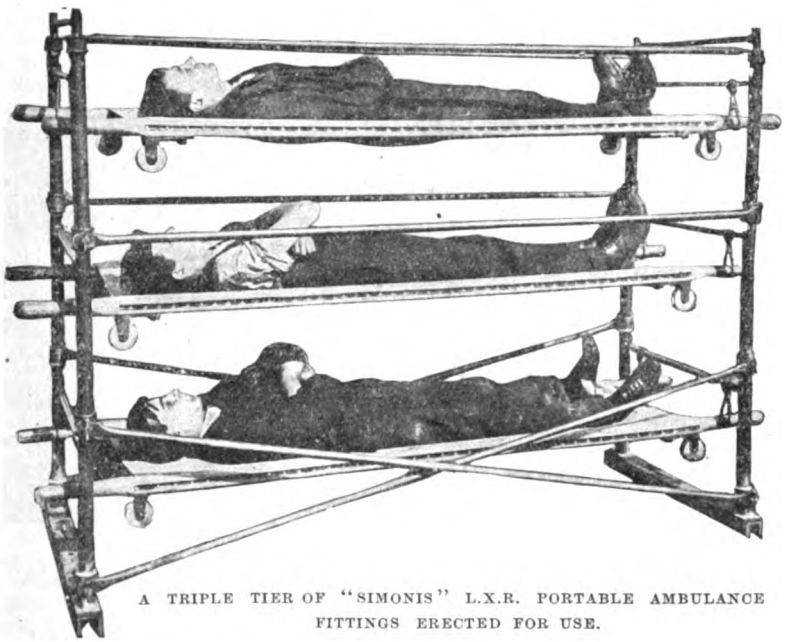
To some extent orders for new work already given out have been modified or cancelled, though in a considerable degree business is being carried on mainly, if not quite, as usual. But with depleted staffs and with many special demands upon them no other course could be expected. Actually many of the railway workshops are working at considerable pressure, doing work for the Admiralty and the War Office as well as to meet the demands of transportation in keeping engines and vehicles in working order, adapting carriages and wagons for conveying horses and war material, equipping and repairing motor road vehicles and horse wagons, and in other ways. At Stratford, Great Eastern Railway, further ambulance vehicles are being equipped, the original ambulance trains having been sent, we understand, to France, for service there. At Crewe, instead of being on short time, the works are exceedingly busy, many of the departments working overtime. This is likely to last for a considerable time, as the London and North Western Company is making motor wagons, etc., for the War Office.

At the transhipping sheds at Crewe a large number of men from the Welsh quarries who were out of work are now doing the work of the Crewe men who have left. One of the largest schools in the town has been fitted up as a hospital for the wounded soldiers, and the expense of this has been defrayed locally.

In other instances skilled boilermakers from the railway shops have been transferred to naval dockyards, while a great deal of work is being done in the carriage and general shops making stretchers, equipping vehicles and otherwise rendering good service.

Reduced Lighting.

GOVERNMENT restrictions upon public lighting have caused notable changes in railway travel conditions. In the suburban trains ideas of privacy and seclusion find evidence, as all the blinds are carefully drawn, with the result that a would-be passenger has to open the door to ascertain whether he is intruding upon a full compartment or one nearly empty. On the Underground lines notices are now attached to some of the windows asking that blinds shall be lowered on the open-air sections. On some of the Underground trains parts of the windows have been painted blue, for a similar purpose. On lines where ordinary third-class compartments have no blinds, the comparative brightness of these portions of the trains becomes specially notable. At several large railway stations the glazing of the roofs has been painted over in a semi-translucent colour.



A TRIPLE TIER OF "SIMONIS" L.X.R. PORTABLE AMBULANCE FITTINGS ERECTED FOR USE.

Portable Ambulance Fittings for Railway Road Vehicles.

ALTHOUGH there are about twenty properly equipped ambulance trains in service on the home railways, besides rest vans and other special vehicles, as also large numbers of motor and horsed road vehicles similarly adapted for the conveyance of wounded soldiers and sailors, the need is continually arising for increasing the equipment, especially in the direction of adaptation to meet needs as they arise. From this point of view, the "Simonis" L.X.R. Portable Ambulance Fittings, supplied by Messrs. Henry Simonis & Co., of Park Royal, Willesden, London, N.W., are of special interest.

These fittings were designed some years ago for the purpose of providing apparatus which, packed in a minimum of space, would furnish an efficient stand for the accommodation of stretcher beds under practically all conditions under which such may be wanted. They are thus equally intended for railway work as for motor or horsed conveyances as for field hospital requirements. The fittings consist of three sets, each holding by means of two clamps a number of iron bars or tubes which, on being undone, fit into each other in only one way, and form an absolutely firm structure to take a number of stretchers in the most efficient method, so that

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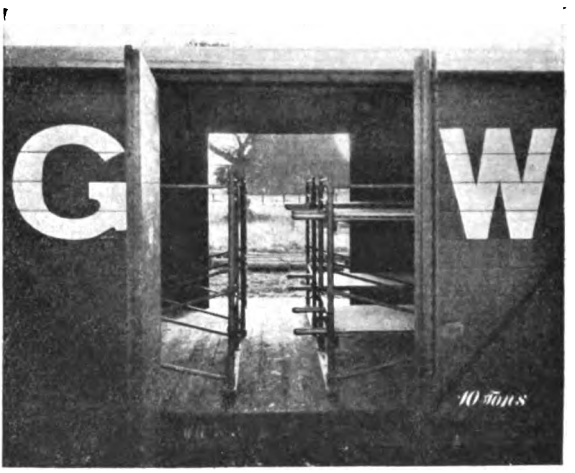
neither road shocks nor railway vibration affect the patients who are being transported, nor can the stretchers roll, a motion which medical authorities dread most while transporting patients. This is achieved by the stretchers being attached to bars, which latter are anchored in the corner pillars and rest on the springs inside these. The stretcher bar, therefore, has no motion except that of the vertical spring. The stretcher is hung on to the bar in very short slings which are obliquely fixed to the bar so that there is a distinct pull on the stretcher from both sides, which, therefore, prevents side sway.

Another governing feature in the construction of the fittings is that they anchor from the base. Thus in dealing with railway cars there is no preparation to the sides of the car, or in dealing with motor cars there is no fixing required to the body itself, which may easily be damaged under service conditions; the fittings in fact, become part and parcel of the chassis frame, and are consequently entirely independent of the over-structure, which only need serve one purpose, namely, that of protection against weather. For transport in open wagons or otherwise erecting in the open the top bars of all fittings have sockets suitable for fixing tent chases. Illustrations are given showing respectively, a triple tier of fittings erected for use, together with a Great Western goods wagon fitted therewith.



GREAT WESTERN RAILWAY GOODS WAGON EQUIPPED WITH "SIMONIS" L.X.R. AMBULANCE FITTINGS.

Signalling on the Metropolitan Railway.

AT a meeting of the London section of the Permanent Way Institution, a paper was read by Mr. W. Challis on "Modern Lay-out of Track Circuits and Signals as in Use on the Metropolitan Railway." Mr. W. Willox, M.Inst.C.E., Past President, occupied the chair, and there was an exceptionally good attendance of members and visitors. The lecturer dealt mainly with the signalling of Wembley Park station completed last February, illustrating his remarks with a signalling diagram of the station, together with wiring and distribution diagrams and a drawing of an upper quadrant signal, a signal motor, relay, etc., being also on exhibition. At Wembley Park the fast and slow lines join north of the station, and there are in addition several sidings, including one extending across the Great Central lines on the level. Points are all manually operated, while signals are electric, both points and signals being controlled by track circuits, and the latter being so designed that when the local lines are set for through working the signals will operate automatically until broken into by the signalman. On the Metropolitan Railway the use of facing point locks has been discontinued, with the approval of the Board of Trade, an electric lock being fitted to the lever, and the points being detected, a maximum slackness of barely one-eighth of an inch being insisted upon, and all points examined at least once a week. Signal motors operate on alternating current, 440 volts, single-phase, 33⅓ cycles, transformed current at 100-110 volts being used for the illuminated diagrams and for lighting signal lamps, each signal having two lamps in parallel on a special lighting circuit. For the track circuits alternating currents at 6 volts are used. The relays are placed in cabinets in the signal-box instead of alongside the track. Signal motors are of induction type, with holding clutch coils, and train stops operate in conjunction therewith, being controlled, however, from the lever contacts and not from the actual signal connections. A distance of 10 ft. into a section constitutes occupancy. Each lever is locked about one-third back, and cannot be fully replaced until properly freed.

Track-Circuits in Theory and in Practice.

MR. CHALLIS pointed out how, when track circuits are installed, it is absolutely necessary for the permanent way and signal departments to co-operate, especially in view of the insulated joints, and the care which has to be observed in working on the track. Considerable stress was laid upon the quality of the ballast, granite being considered the best for track circuits, and ashes and slag the worst on the ground of leakage; but it was pointed out that it is still possible to compensate for leakage and maintain track circuits operative though at greater current expense. The chief difficulty is variable places, sometimes conductive to leakage and at other times fairly good. At Wembley Park there are about 300 trains daily, and about 25 per hour at busy periods. So far the failures have amounted only to seven, three attributed to the permanent way, three to signal mechanism

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and one to a signalman, but all merely resulted in placing the signal to danger.

New Factors Introduced by Modern Development in Signalling.

MR. WILLOX pointed out that the Metropolitan, with the East London, also carried out under his direction, is the only line in London where the signalling is entirely electric. The elimination of facing point locks constitutes a great saving, although full traffic security is assured, and in consequence of the use of train stops it is now allowable for a train to approach a junction at the same time as a road is set for another train to cross its track; this may occur at Wembley Park, Finchley Road, Baker Street, and Liverpool Street. He objected to Mr. Challis describing the seven failures referred to as such; actually they were instances where the signals had done their work in providing against possible eventualities. He also pointed out that as the signal and train stop connections are taken from the lever there is a double safeguard; if a signal should hang off, the train stop will still go on and trip a train. On the Circle section the signalling circuits are D.C., but as currents may come in from various sources it necessitates metallic return, and even then may interfere with the block instruments. Alternating current eliminates these troubles, besides possessing other advantages as suggested.

"Tripping" Tests.

MR. CHALLIS also referred to "tripping" tests carried out with passenger trains tripped when going hard, and yet pulled up well within safe distances. In the case of goods trains, with the engine only tripped (the brake van not being available until the guard can realise that his assistance is required), distances of 500 to 600 ft. were required to pull up, but these trains are specially looked after and run under clearly defined rules. He also mentioned that ordinary signals on another section are fitted with mechanical train stops, but these are operated from the signal rod, though it was suggested that signal and trip gear might be separately connected to the lever.

Railway Bills in Parliament.

IT could hardly be expected that the forthcoming Parliamentary Session would have to deal with many Bills promoted by railway companies, and those which are to be considered are more or less of an omnibus character. There are eight railway Bills and three Provisional Orders in Scotland. Of these, the London, Chatham and Dover and Mersey Bills are mainly financial, relating to the issue of additional capital, payment of interest on debenture stock, redemption thereof, issue of certificates to bearer for stocks and debentures, and other allied matters. The Caledonian, Great Central, Great Eastern, Great North of Scotland, Highland, Metropolitan District, Seaforth and Sefton Junction Railways also ask for powers of a corresponding character or relating to other financial aspects.

On a general basis the Caledonian Company asks for powers to make widenings in the Monkland, Bothwell and Coatbridge districts, to run motor omnibuses, and for detail improvements. The Great Central Railway Bill is concerned with its relations with the Mansfield Railway, and extensions of time for various widenings and other works. In large measure the Great Eastern Railway is promoting a similar Bill to that which failed to pass in 1914, but the proposals made are of a very comprehensive nature, including widenings, purchase of additional land (including the Thames Ironworks), new lines and bridges, alteration or amendment of the New Pension Supplemental Scheme, provision against stone-throwing at trains, unlawful use of the communication cord, and other matters.

A widening between Dyce and Ellon, also additions and alterations at Aberdeen, affecting the Palace Hotel, and other matters are projected by the Great North of Scotland Railway, while the Highland Railway propose to widen between Clachnaharry and Clunes, north of Inverness. The Metropolitan District Bill covers extensions of time and arrangements with the Wimbledon and Sutton line and for the leasing thereof to the District Company; also widenings at Hammersmith and Whitechapel, leasing to other companies of land for goods yards, etc., and the supply of electrical energy from the Lots Road Power Station to the Central London and other railways.

The Mullingar and Kells Railway is projected to connect Mullingar (Midland Great Western Railway) with the Oldcastle branch of the Great Northern of Ireland Railway, with running powers into Mullingar and Kells stations. The Seaforth and Sefton Junction Bill provides for increase of capital on the basis of guarantees by the Great Central and Great Northern Railways, appointment of a joint committee, substitution of nominated for elected directors, revival of powers, etc. The Worksop and Bawtry Railway is designed to serve projected collieries at Firbeck and Harworth, and with junctions with the Great Central, Midland, Great Northern, South Yorkshire Joint and other lines, and powers are sought for running powers, working agreements, etc.

Improving London!

DURING recent years the architectural shortcomings of the Metropolis, and more especially those alleged against certain railway stations and bridges—Charing Cross bridge in particular—have been criticised somewhat severely in papers read before various societies. Some of these have been referred to in these pages, but most of them hardly warrant serious attention seeing that they presuppose exceedingly drastic and expensive alterations which hardly come within the range of practical railway politics. Indeed, in most cases they represent the setting forth of certain pet ideas and take little account of practical possibilities; they are, in fact, usually so academic in character that they are hardly worth consideration, except in so far as

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the proposals possess interest on their own account, and apart from their merits or the reverse.

It is not easy to understand why the Charing Cross and Cannon Street bridges over the river should be singled out for so much criticism. The former is more utilitarian than ornamental, it is true, but it has engineering if not artistic interest. Apparently, however, the general objection is to these structures altogether, and so the gentlemen who are amusing themselves by "improving" London in this way suggest that Charing Cross bridge—if not that at Cannon Street also, together with the "Blackfriars Horror"—should be entirely replaced by an artistic road bridge, and on the south side there should be an entirely new terminal close to Waterloo, with of course a new series of approach roads designed to give prominence to the special architecture of the proposed station. As a speaker at a recent discussion—needless to say, one by architects—remarked: "By the transference of the station to the south side, you would get a very valuable building site where Charing Cross Station now stands, which would probably pay for the whole of the new bridge, if not for the station. The transferenceof the South Eastern Station to the south side would also relieve the traffic of London by Charing Cross considerably, because, though vehicles from the south would cross the bridge, they would have six different outlets, any one of which could be taken to disperse the traffic. The juxtaposition also of those two great stations would, from the military point of view, be very useful in the transference of troops from Southampton to Dover and from the north generally to the south and south-west."

A New Use for the "Underground."

ARISING out of the discussion suggesting these remarks,* a curious proposal was advanced. In some respects the scheme was not very clearly set forth, but apparently it amounted to the South Eastern and Chatham being continued from the Grosvenor Road bridge to the District lines at Victoria, so that suburban trains could travel by that route to Cannon Street, thence passing by a new bridge—of course, this must be architectural and artistic!—over the river to connect up with existing lines at London Bridge. The difficulty of the "Underground" would be met by utilising the funds raised by the sale of the portion involved to the South Eastern and Chatham Railway, to construct a new "tube" line from Victoria along Victoria Street, Whitehall, Strand and Fleet Street, thus following the main road of traffic. Main line traffic would be dealt with at London Bridge, Victoria and the new south-side terminus. Another speaker claimed that by gathering together all the approaches on the South Eastern and Chatham systems "at one point near Catford, as indicated on the official railway map, and by constructing from that point underground lines both to Victoria and to Cannon Street, that the essentials of the present service would be maintained, that only 8½ miles of new line would be required, that roughly 29 miles of viaduct, etc., could be removed without any sacrifice, and that the proceeds of the sale of the land upon which the latter run ought to go a long way towards defraying the cost of the new line. Not the least of the advantages which would accrue from such a scheme would be the removal of all the iron bridges across the Thames, the removal of the iron bridge across Ludgate Hill and the station adjoining, the possibility of extending London Bridge Station by the Brighton Company and a proper treatment of its approach, and also the possibility of a proper treatment of Waterloo Station (now so badly spoilt by the South Eastern lines)." All of which is most interesting and perhaps partially justifiable from the practical point of view; but hardly appears to possess features which introduce any likelihood of realisation, at least for many years to come.

* On a paper read by Mr. Paul Waterhouse before the Royal Institute of British Architects.

Reinforced Concrete Structures on the Great Central Railway.

MR. J. B. BALL, M.Inst.C.E., Great Central Railway, recently read a paper before the Institute of Civil Engineers on this subject. He mentioned that the Great Central Railway have completed within the last six years several considerable works in reinforced concrete, the more important of which include a bridge carrying a public road over their main lines at Ashton-under-Lyne—believed to be one of the heaviest reinforced-concrete bridges of its type yet constructed in England—a bridge carrying a new road and tramway over the Grimsby District Light Railway at Immingham Dock, and several reinforced-concrete bridges in the dock-area at Immingham, as well as a large engine shed at Immingham Dock, the foundations and pits of which are constructed in reinforced-concrete throughout. The overbridge at Ashton-under-Lyne consists of parallel girders of three spans. The main girders also form the parapets of the bridge. On a level with the bottom booms are formed the main deck-beams or cross girders, and between these again are the smaller deck-beams parallel to the main girders, supporting the reinforced concrete decking. The entire superstructure is reinforced with round bars on the Hennebique system. The actual cost of the work as carried out in reinforced concrete amounted to £5,917. The estimated cost of a similar structure in steel and masonry was £8,390.

The reinforced-concrete bridge carrying a new road and tramway over the Grimsby District Light Railway is also designed on the Hennebique system, and consists of a roadway 40 ft. wide extending over two spans of 37 ft. 2 in. and 31 ft. 2 in. respectively. There are five main longitudinal beams, the two outer of which also carry a reinforced parapet. The actual cost of this bridge carried out in reinforced concrete was £2,939. The estimated cost of a similar structure in steelwork and masonry was £3,500.

In the case of the set of four high-level railway

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bridges at Immingham Dock, these are all skew spans of the same construction, each bridge carrying four tracks over a siding for empty wagons, and forming practically a tunnel 86 ft. long. The average cost of these bridges in reinforced concrete was £3,024 each. The estimated cost of a similar structure in steelwork and masonry was £3,800 each.

Reference was also made to the use of reinforced-concrete foundations and pits for the engine-shed at Immingham Dock. This work consists of a reinforced-concrete raft, so spread that the load on the ground nowhere exceeds 10 cwt. per square foot, and the engine pits form part of the raft. The floor of the shed is carried on the pit walls; it consists of a reinforced-concrete deck between each of the pits, and is not in any way dependent on the earth filling underneath. There are in addition fourteen independent reinforced-concrete engine-pits outside the shed of a similar design to those in the shed, but without any flooring between. The actual cost of the work as carried out in reinforced concrete (engine-pits and foundations only) was £8,850. The amount of an actual tender received for brick pits on a reinforced-concrete slab was £12,920. An estimate for brick pits on concrete carried on timber piling was £15,150.

Engineering Developments at Chalk Farm: London and North Western Railway.

Reference has already been made to the fact that in connection with the electrification of the Euston-Watford route of the London and North Western Railway, and of the North London system, extensive alterations are being carried out by the London and North Western Company, but it is not generally realised how comprehensive and interesting is the work involved at Chalk Farm. These alterations are designed so that electric and "slow steam" traffic can be worked into and out of Euston independently of the main line traffic, while in connection with the Broad Street route the electric and slow routes are to be separated—with inter-connections in all required directions so that no train need foul any line of opposite direction or any route of same direction with which it is not required to connect—and the electric lines continued through new "tube" tunnels alongside the existing Primrose Hill tunnels to Loudoun Road and Kilburn stations, at Queens Park connecting with the "Bakerloo" tube extension and continuing over the new local lines already provided to Watford.

At Chalk Farm the London and North Western station has at present five lines, an engine road, the down main running behind the down platform, the down platform line, and up main and up slow line with an island platform between. On the other side the North London station consists of two islands with up and down through lines outside and a down road in the centre, signalled for through traffic, but usually employed for terminal trains from and to Broad Street. Between the two sections are shunting necks and train-waiting lines associated with Camden goods depôt, and beyond the North London up line is a goods line. Further along there are surface cross-overs between the fast lines and the slow line tunnel under Primrose Hill, to which tunnel also the goods and North London tracks give access.

New Arrangements Provided For.

In the station the North London portion will remain substantially as at present, but the London and North Western station is to be entirely removed though the site will receive an outer down main, down and up local lines (to be used also by electric trains) in the centre, and the up main, with goods and engine lines as already existing. Beyond the station the down main will be the only line unaltered. From the site of the present station the down and up slow lines will descend between retaining walls to pass under the up main line, which will be raised somewhat to co-operate. At the foot of the grade the down local line first divides, one section, for down slow traffic, rising to the existing slow line tunnel, while the other keeps at the low level and passes by cut-and-cover work under all lines to the new down "tube" on the east side by which electric trains will pass under Primrose Hill. The up slow line descends from the existing tunnel and before it comes alongside the down slow line is joined by the up electric line from the new tube for up electric traffic. The down electric line passes under the up slow before it connects with the up electric lines, so that there is no crossing of tracks.

On the North London side the steam lines will continue nearly as at present to the slow line tunnel, but just beyond the station will put off a new electric line falling and continuing in cut-and-cover to join the down electric line from Euston near the mouth of the tube, while the up electric line will diverge near the mouth of the tube and rise thence to the station to join the up North London line.

From the slow line tunnel an up empty carriage line will diverge and descend steeply to a new line extending in a low level tube from the extreme east of the area under notice, and passing diagonally under the running lines and the goods yard will rise on the down side near the Regent's Canal bridge to connect with the engine lines into Euston. The purpose of this line is to convey the numerous empty carriage trains from Willesden from the up slow line right across to the down side, and so, by means of lines already existing, to the departure side of Euston station.

Under Primrose Hill the electric lines will pass in separate "tubes," at a lower level than existing lines, rising to their level at Loudoun Road. These tubes will be 16 ft. 4 in. diameter, and constructed by the usual shield method, except that the rings will be 2 ft. 6 in. long instead of 20 in. The empty carriage line tunnel is also constructed on "tube" principles.

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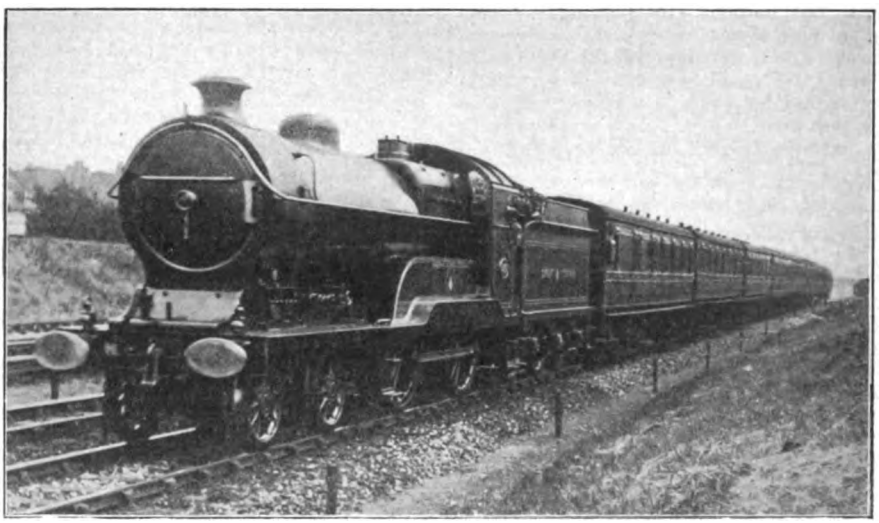
Metropolitan Railway Improvements.

A CONSIDERABLE portion of the Metropolitan Railway widenings north of Finchley Road is now in use, but at Kilburn the construction of the viaduct is still in progress. The general scheme commenced with the demolition of two tunnels at Finchley Road. From this point the railway branches from two to four rails, and the traffic is divided here into local and express trains. Most of the new line has been laid on land belonging to the Metropolitan Railway, and lying parallel with the existing lines; but between West Hampstead and Kilburn stations it was necessary to construct a lofty viaduct, passing over the London and North Western Railway lines and a number of streets and thoroughfares. This viaduct, with approaches, is over ¼ mile in length, and forms an engineering work of considerable magnitude. The bridge over the London and North Western Railway, built on the skew, has two clear spans of 97 and of 80 ft., the girders being 7 ft. 6 in. at ends and 9 ft. 6 in. in centre. The bridge is of the hog-back plate type, with pressed trough flooring. Total weight about 300 tons. The bridge crossing the Iverson Road weighs about 300 tons, is of the hog-back lattice type, having a clear span on skew of 99 ft., with plate flooring. Girders are 8 ft. 6 in. at end and 13 ft. at centre of bridge. The bridge crossing Loveridge Road has a clear span of 80 ft. between the bearings. It is of the lattice type, plate flooring, with girders 10 ft. 6 in. at ends and 13 ft. in centre, and has a weight of about 180 tons. The largest bridge, that at Kilburn High Road, which weighs about 600 tons, has a clear span of 147 ft. centre and 37 ft. sides. This bridge is also of the lattice type, with plate flooring, girders being 11 ft. 6 in. at ends, 15 ft. 6 in. at centre. The two spans are 10 ft. 6 in. deep. This bridge will have a cast-iron ornamental parapet 7 ft. above rail level. All the railway lines will be carried over the bridges on ballast. The engineer is Mr. W. Willox, M.I.C.E., engineer to the Metropolitan Railway. The contractors for the bridges over Kilburn High Road and Loveridge Road are Messrs. E. C. & J. Keay, of Darlaston, and for the bridges over Iverson Road and the North Western Railway Messrs. Eastwood, Szwingler & Co., of Derby, under the superintendence of Mr. O. G. C. Drury, resident engineer.

Feedwater Heating.

ON several occasions reference has been made to the introduction of feedwater heating on the Home, Colonial and South American railways, particularly in connection with the Weir equipment. This apparatus is now used on many railways, and the number of engines so fitted is by no means a small one. Usually both the Weir pump and heater are installed, but in a few cases the pump alone is used in conjunction with a railway company's own design of heater, while there is a decided tendency to use the Weir feed pump also for ordinary boiler feeding, especially in hot countries. The Weir apparatus has already been described in the RAILWAY MAGAZINE, but a new booklet published by Messrs. G. and J. Weir, Ltd., of Cathcart, Glasgow, directs attention to various aspects further dealt with. As regards railways using this apparatus, it is now simpler to specify those which have not yet followed the lead given by no fewer than 12 of the leading British lines, 13 or 14 Colonial and Indian Administrations and South American companies, besides several foreign systems. Some of these are experimental installations, but



Photo] [*F. W. Curtis.*

GREAT CENTRAL RAILWAY DOWN SHEFFIELD EXPRESS.

4-4-0 locomotive No 437, *Charles Stuart Wortley.*

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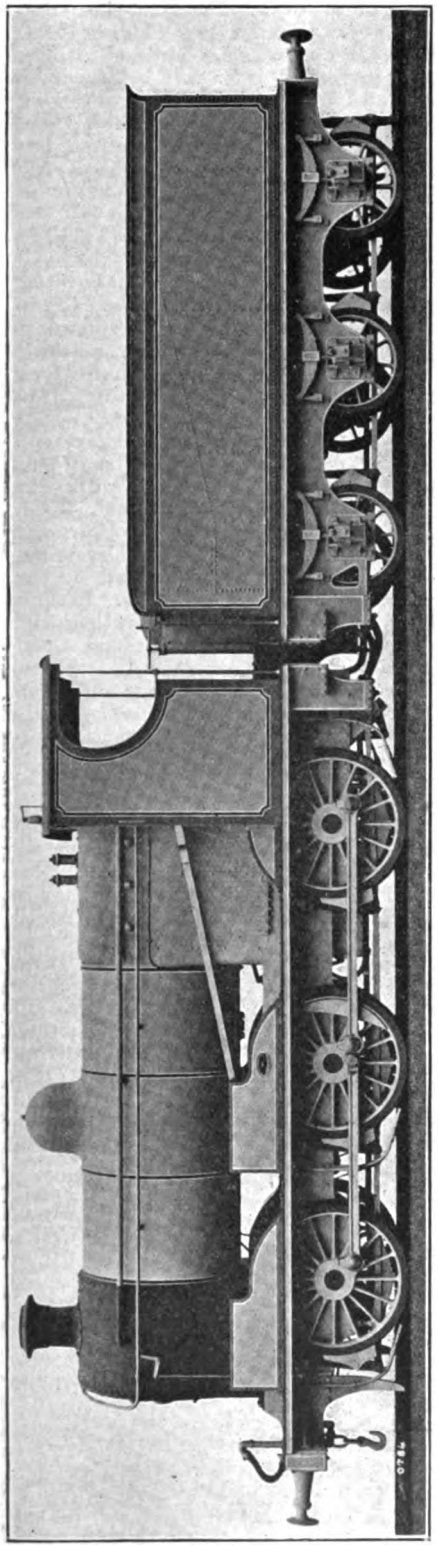

NEW 0–6–0 LOCOMOTIVE: BELFAST AND COUNTY DOWN RAILWAY.

in several cases considerable numbers of engines are fitted, and equipments are now made on a standard basis in view of decisive results previously obtained.

As a result of careful investigations and trials carried out in ordinary service it is claimed that by using an efficient exhaust steam feedwater heater fuel economies of at least 10 per cent. are realised, and that, without impugning the value of injectors, an efficient and reliable independent direct-acting feed pump is in many cases a more suitable apparatus for boiler feeding than any form of injector. These claims are not advanced only upon the results of isolated installations, but also upon tests with series of engines. Moreover, it has to be remembered that superheating and feedwater heating are not opposed; indeed, they are virtually independent methods of achieving operating economics, and can be allied, as is actually the case in many instances. Summarising, the advantages of feedwater heating are (1) waste heat is utilised; (2) the boiler, being supplied with hot feedwater, is relieved in the interests of maintenance; (3) the amount of heat required for steam generation is reduced in proportion with the rise in feed temperature; (4) and a feed pump is as good as and sometimes better than an injector, while with hot feed it is a necessity. Much, of course, depends upon the attributes of the apparatus employed, and in this case the Weir heater has a good reputation in service, while the pump includes features based upon long experience and developed in actual traffic working, whereby running conditions and requirements are fully complied with. The apparatus can be easily applied to existing locomotives, and calls for hardly any attention in service. For use in hot countries the Weir feed pump is sometimes installed in place of one injector. When applied in cold countries a simple steam circulation system is added to meet standing conditions, but is otherwise as applicable as in other installations. Messrs. Weir will be pleased to forward particulars of equipments in use and of results realised.

New Goods Engine, Belfast and County Down Railway.

On this page is illustrated a new main line goods engine for the Belfast and County Down Railway, built by Messrs. Beyer, Peacock and Co., Ltd., of Manchester, to a specification prepared by Mr. R. G. Miller, Locomotive Superintendent. The engine is the largest one ever obtained by the company. Leading dimensions are:—Cylinders, 18 in. by 26 in.; pressure, 170 lbs. per sq. in.; heating surface, fire box, 110 sq. ft.; tubes, 1,328 sq. ft.; total, 1,438 sq. ft.; grate area, 20 sq. ft.; weight in working order, 44 tons; engine and tender, 73 tons.

Christmas Holiday Arrangements.

On another page reference is made to the Christmas Holiday facilities arranged by the Great Eastern Railway. In this respect, however, all the leading railways are doing "business as usual," with in many instances certain special facilities suited to the conditions which now

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obtain; and reference may be made to the following, seeing that this number of the RAILWAY MAGAZINE will be published some days before Christmas.

The London and South Western Railway facilities from London to the South and West of England include the regular weekly excursions to these parts. There will, however, be certain important additions and alterations for the Christmas week. For the convenience of those who will be going home on Christmas Eve, 24th December, special fast trains, at excursion and cheap "week-end" fares, will leave Waterloo station for various centres. On Christmas Day the services will be as on Sundays, with additional facilities, including special trains from Waterloo at 6.10 a.m. for Salisbury, Yeovil, Exeter, etc., and at 10.15 a.m. for Southampton, Winchester, Brockenhurst, Bournemouth, etc.

The Lancashire and Yorkshire Railway Company has a variety of programmes for London, Wales, the Midlands, and the South Coast, Scotland, and the various important districts it serves, copies of which can be obtained from the Superintendent of the Line, Victoria station, Manchester, or at the stations. Winter excursions to Ireland are arranged for every Friday and Saturday until further notice (*viâ* Fleetwood, Heysham, Liverpool, or Holyhead).

The South Eastern and Chatham Railway has attractive programmes for the various seaside and other resorts it serves. Full particulars as to times of trains, alterations in train services, etc., will be found in the holiday programme and special service supplement.

The Brighton Railway Company are now running their full service of trains, with one or two minor exceptions, and their programme of cheap tickets this year is on a very liberal scale, including particulars of early and late trains as required to suit the needs of Christmas travellers, and facilities to suit everyone.

A convenient cheap ticket will be issued from Victoria, London Bridge, Kensington (Addison Road) and certain main line suburban stations to most seaside and health resorts by all trains on December 24th, 25th, 26th and 27th, available to return from December 26th to 29th, but tickets issued on December 24th, 25th and 26th will not be available for return on date of issue. Cheap excursion tickets for 9 or 16 days will be issued by certain trains on December 24th to most South Coast towns. The usual cheap day return tickets to Brighton, Worthing, Seaford, Eastbourne, Bexhill, St. Leonards, Hastings, Littlehampton, and Bognor will be issued as usual, and on Christmas Day and Boxing Day there will be a 3s. excursion to Brighton, Hove and Worthing. On Christmas Day the ordinary Sunday service will be run, including the "Southern Belle," from Victoria to Brighton in 60 minutes. The 10.40 a.m. Pullman and 3rd class express Victoria to Eastbourne will not run on Christmas Day.

By the Metropolitan Railway special facilities are provided for the Christmas holidays. Cheap week-end tickets will be issued on Thursday, December 24th, and following days, available for return on Saturday, in addition to their ordinary availabilities. Day and half-day trips will be available each day of the holiday period to stations to Uxbridge and Aylesbury, and Chesham, with further arrangements on Boxing Day, including a day excursion to Waddesdon Manor, Quainton Road, Grandborough Road, Verney Junction, Waddesdon, Wotton and Brill. Should the weather be suitable, pedestrian and bicycle tour tickets issued by the Metropolitan Railway, are available. Readers may be referred to special publications and guides issued by the Metropolitan and Great Central Railways.

The Great Central Company issue an attractive programme intended for those who are spending their Christmas in the Midlands, Yorkshire, Lancashire, Lincolnshire, or North of England. On Thursday, 24th December, special expresses will leave Marylebone at suitable times for over 500 different stations. The tickets, issued at extremely low fares, will be available for return on the following Saturday, Sunday, Monday, and Thursday, enabling those who may so desire to spend the special Bank Holiday period with their friends. Breakfast, luncheon, or restaurant cars will be attached to the trains, and the compartments represent the acme of comfort, being well lighted, and maintained at a genial temperature. Shopkeepers and others whose business will keep them in town until late on Thursday evening will have the advantage of suitable night trains.

In the case of other railways corresponding facilities are available to meet the special requirements of the holiday period.

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ALTHOUGH dated January, this magazine will be published several days before Christmas, and a record of the improved Yuletide arrangements of the Great Eastern Railway will therefore be of value to many readers. Those desirous of spending the Christmas holiday with friends in East Anglia are provided for by the running of *mid-day* and *evening* excursions from London on Christmas Eve. Tickets will be issued to the Eastern Counties and also to Lincolnshire, Lancashire, Yorkshire, North East District, etc. Excursion tickets will also be issued on December 24th and 31st to certain north-eastern stations and Scotland. Tickets (ordinary, excursion, etc.) are obtainable in advance at Liverpool Street station or at the company's West End, City and other booking offices. The service of main line trains will be augmented by the addition of special and relieving trains on December 22nd, 23rd and 24th, whilst for the convenience of those detained late in town on Christmas Eve no less than seven midnight trains will be run from Liverpool Street to various parts of the Eastern Counties. On Christmas Day, with certain exceptions, the ordinary Sunday train service will be in force, and special trains will be run on many of the branch lines in connection with trains from and to London. A special train will leave Liverpool Street at 5.5 a.m. for Ipswich, calling at the principal intermediate stations. On Boxing Day the train service will be considerably altered, some of the trains being cancelled or modified. On Monday, December 28th, there will be slight alterations in the train service. Senders of Christmas hampers and parcels are requested to fasten the address to each packet securely, and as an additional precaution against loss or delay are recommended to place a duplicate address of the consignee inside each package, together with the name and address of the sender. On page 84 is a half-tone illustration of the Great Eastern Railway "Christmas Excursions" wrapper. The original of this seasonable design is an elegant production in charming colouring by Miss Prytherch, who, as RAILWAY MAGAZINE readers are aware, has earned a great reputation as a railway holiday artist.

* * *

THE Directors of the Hull and Barnsley Railway have elected Col. Charles William Trotter as Chairman of the Company in the place of the late Sir William S. Wright. Col. Trotter, who is at present serving in His Majesty's forces in Nottinghamshire, was elected Vice-Chairman of the Company in February this year to fill the vacancy caused by the death of Mr. Chas. Poston, and his father, Mr. William Trotter, was Chairman of the Company for the years 1900–07. Col. Trotter is a member of the well-known stockbroking firm in London, Messrs. James Capel & Co., and he is also a trustee and manager of the London Stock Exchange, and the Chairman of the Sheffield District Railway. Mr. J. H. Fisher, who has been a Director of the Company since January, 1911, and is a member of the firm of Tealby & Co., timber merchants, of Hull, has been elected as Deputy-Chairman of the Company, and Mr. Edward Watkin, the General Manager, will represent the Company on the Humber Conservancy Board.

* * *

WITH the death of Sir Alfred Mellor Watkin, a Director of the South Eastern Railway, at the age of sixty-eight years, a once famous name is lost to the railway world. The deceased was the only son of Sir Edward William Watkin, the first baronet, and who was for many years Chairman of the South Eastern Railway Company. Sir Alfred Watkin was born in 1846, and was apprenticed to the locomotive department of the West Midland Railway in 1863, and a year later was transferred to the Manchester, Sheffield and Lincolnshire Railway (now the Great Central). He served as an engine driver in 1865, and as locomotive inspector on the London, Chatham and Dover Railway during 1867, and the following year transferred to the South Eastern Railway. In 1873 he became Locomotive Superintendent of that railway. He was elected a Director in 1878, so that he held that position for the long period of thirty-six years. He was appointed Chairman of the Locomotive Committee of the South Eastern Railway for the twenty years 1880–1900.

* * *

BY the retirement of Mr. John Avis, M.V.O., Continental Traffic Manager, the South Eastern and Chatham Railway loses one of its most honoured departmental officers. Mr. Avis has been closely identified with the Continental traffic of the South Eastern and Chatham Railway for more than a quarter of a century, and in the pursuit of his ordinary duties has done much to promote the excellent relationship that now exists between England and France. He was more actively engaged than any one else in the frequent journeys which King Edward made

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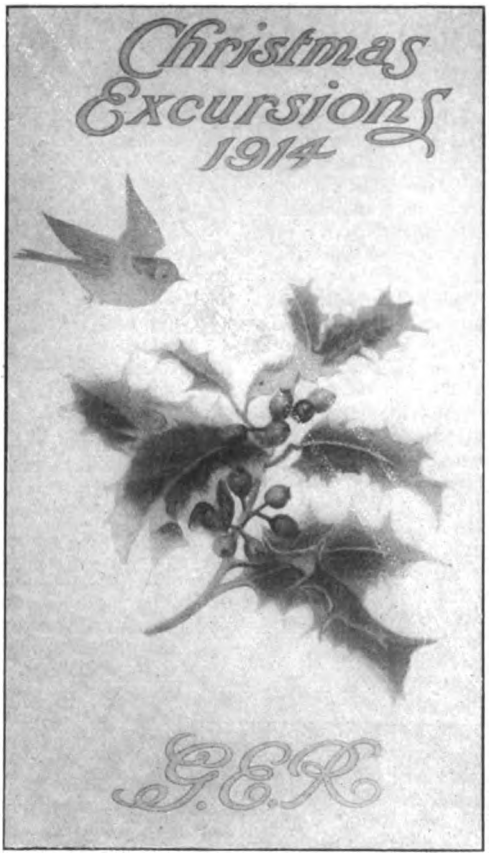
to the Continent, and has in like manner completed all the arrangements for the visits which in recent years foreign rulers and princes have paid to this country. He was in the service of the London, Chatham and Dover Company long before its amalgamation with the South Eastern, and from July, 1899, was Chief Assistant (Continental Department) to the General Manager. In connection with the changes made early in 1911, due to the retirement of Mr. Vincent W. Hill from the General Managership, Mr. Avis was given the appointment he is now relinquishing.

* * *

REFERRING to the list of London and North Western four-cylinder passenger engines ("Claughton" class) given on page 409 of the November RAILWAY MAGAZINE, the two last, *Charles J. Cropper* and *Lord Kitchener*, have now been turned out and are numbered 1567 and 2401 respectively. Five additional engines of the "Precursor" (4–4–0) type are being equipped with the Schmidt superheater and piston valves; these include Nos. 1395 *Harbinger* and 2513 *Levens*, which are at work. Nos. 1905 *Black Diamond* and 1946 *Diadem*, four-cylinder compounds respectively of the "Jubilee" and "Alfred the Great" classes, have been converted to simple with two inside cylinders 18½ in. by 24 in. diameter. Both these engines, it may be mentioned, still retain the words "F. W. Webb's System" on the name-plates. Including the two mentioned above, there are now eight of these engines running, five being formerly of the "Jubilee" class, and the remaining three of the "Alfred the Great" class. The six engines previously converted are:—"Jubilee" class: 1913 *Canopus*, 1918 *Renown*, 1921 *John o' Gaunt* (formerly *T. H. Ismay*), 1935 *Collingwood*; "Alfred the Great" class: 1951 *Bacchante*, 1971 *Euryalus*.

* * *

A NEW list of the names, numbers and types of Great Western Railway engines, with photographic] reproductions, with particulars of cylinders, boiler, heating surface, wheels, water capacity of tender, and working pressure, has been published by the *Great Western Railway Magazine*. Several pages are devoted to an introduction dealing historically with the practice of naming locomotives, and a large amount of interesting information—much of which is now published for the first time—will be found therein. The production of successive types of Great Western Railway engines is traced from the days of the old broad-gauge to the present time. The price of the booklet is 6d. (by post 7d.).



A TASTEFUL CHRISTMAS PROGRAMME COVER (THE ORIGINAL IS ARTISTICALLY COLOURED) OF THE GREAT EASTERN RAILWAY COMPANY'S EXCURSION PROGRAMME.

* * *

ELECTRIC token instruments of a new design have been installed on the Marlow single line branch, Great Western Railway, in place of electric train staff instruments. The principal advantage of the new instruments over electric train staff and tablet equipment is that the tokens are smaller, lighter, and, consequently, much easier to handle, while the instruments contain fewer working parts, and are designed very simply. Similar instruments have been installed on the single line between St. Blazey Bridge and Luxulyan, with an intermediate instrument at Pontsmill.

* * *

IN the November RAILWAY MAGAZINE reference was made to changes in locomotive nomenclature due to war influences. A further rechristening has taken place on the London and North Western Railway, No. 2583 *Teutonic*—a "Precursor" successor to the once-famous three-cylinder compound engine of the same name—taking the title of *The Tsar*.

* * *

IN reference to the new 4–4–0 superheater locomotives designed by Mr. Bowman Malcolm for the Midland (Northern Counties Committee) lines in Ireland, and illustrated on page 496 of the December RAILWAY MAGAZINE, we are asked to point out that the engines are virtually duplicates of the standard 4–4–0 compound

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express passenger engines which have been at work for several years, except that the new class is non-compound and superheated.

* * *

His many friends in the railway world will be interested to know that Mr. F. W. Crossley, of Irish Tourist Development, has written and composed a recruiting song, which is being sold for the benefit of those deserving charities, the National Relief and Belgian Relief Funds. It will be remembered that Mr. Crossley compiled a book of railway stories, the sale of which substantially increased the funds of the Railway Benevolent Institution. The song is entitled "Now or Never," and is published by Messrs. Pigott & Co., Dublin, price 1s. With the desire to obtain the co-operation of those in the railway service in this object, Mr. Crossley proposes to pay to the Railway Benevolent Fund 5s. on every 20 copies sold by railway men. Those willing to help in this manner will be good enough to communicate with Mr. A. E. Mills, Sec. of the Railway Benevolent Institution, Clearing House, London.

* * *

In order to promote the exchange of ideas and discussion of subjects of mutual interest to Locomotive Running Superintendents, an Association of Locomotive Running Superintendents has been formed. Mr. W. G. P. Maclure, Locomotive Running Superintendent, Great Central Railway, has been appointed President for the first year, this position being held in order of seniority. A portrait of Mr. Maclure was given in the November Railway Magazine.

* * *

At an early date it is expected that the large 2-8-0 mineral engines of the Somerset and Dorset Joint Railway will be given access to the Bath sheds and repairing shops. So far these engines have been stationed at Radstock. The approach to the Bath sheds is over Midland metals; and in November, 1914, the strengthening of two under-bridges between the Somerset and Dorset junction and the sheds commenced. This work completed, the mammoth mineral engines will be enabled to enter their new quarters. They were pronounced too heavy for the original structures.

* * *

Mr. Gilbert S. Szlumper, assistant to Mr. H. A. Walker, General Manager, London and South Western Railway, and Secretary to the Railway Executive Committee, forms the subject of the following announcement from the *London Gazette*: "Lieutenant Gilbert S. Szlumper, A.M.I.C.E., Hamp. (Fortress) Royal Engineer, (T), to be Railway Transport Officer, graded for purposes of pay as Staff Captain, to date from July 31st, 1914."

* * *

Mr. J. L. Clewes, Secretary and General Manager of the Londonderry and Lough Swilly and Burtonport and Letterkenny Railways, has been elected a member of the Managers' Conference of the Irish Railway Clearing House, and of the Londonderry Chamber of Commerce.

Capt. C. L. Conacher, R.T.O. (late Cambrian Railways) has now been transferred, on promotion, to the staff of Col. Pringle, R.E., Deputy-Director of Railway Transport, War Office, for special duty in that department.

* * *

Mr. Walter Cunliffe, Governor of the Bank of England, and a Director of the North Eastern Railway, upon whom a barony has been conferred by the King, will take the title of Lord Cunliffe of Headley.

* * *

An order for six locomotives for the Taff Vale Railway, placed in the summer with a German firm, has been transferred to the North British Locomotive Co., Ltd.

* * *

The Great Western Railway exhibit at the Anglo-American Exhibition has been awarded a Grand Prize.

* * *

Sir Robert Turnbull, M.V.O., late General Manager and Superintendent of the Line, has been appointed a Director of the London and North Western Railway Company.

* * *

Mr. J. W. Harris has been appointed Chief Clerk to the Superintendent of the Line, London and North Western Railway, in place of Mr. E. C. Grindley, promoted to the position of Indoor Assistant to the Superintendent.

* * *

We regret to record the death of Mr. John W. Williams, who in 1902 resigned his position in charge of the Midland Railway Locomotive Department at St. Pancras station and joined the staff of Bell's United Asbestos Company. Mr. Williams took a great interest in the Railway Magazine from the time of its inception. He took a leading part in the institution of the Railway Convalescent Home at Herne Bay. In 1899 he became a member of the Board of Trustees and after leaving the railway service was made an honorary member of the Committee of Management. Sixty-one years of age, he has left behind him a wide circle of friends.

* * *

Sir W. G. Armstrong, Whitworth & Co., Ltd., recently launched at Newcastle-on-Tyne a car ferry steamship for the Prince Edward Island service. The new vessel is designed in accordance with the experience gained by the firm in building a number of ice-breaking steamers now in use in the Baltic Sea and on Lake Baikal, on the Trans-Siberian Railway. She is designed and built for the special service of transporting trains across the Northumberland Strait from Cape Tormentine, N.B., to Carleton Point, P.E.I., at all seasons. This passage is frozen over for some months in the year, and provision has had to be made for breaking ice

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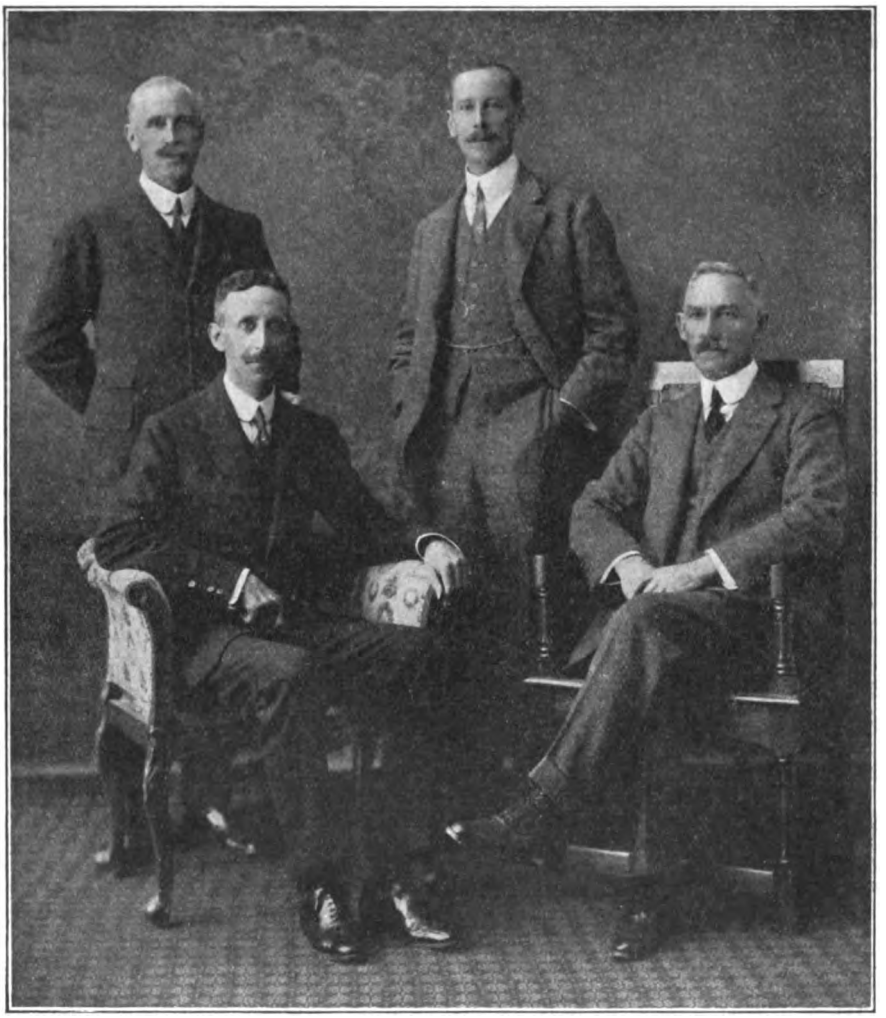
which will probably attain a thickness of some 3 to 4 ft. The vessel has an upper or railway deck with a superstructure in which is provided accommodation for passengers and officers. The cars will be run over a hinged gangway at the after end of the vessel on to the railway deck, and will be secured in position by suitable appliances so as to avoid any chance of breaking loose in a rough sea.

FOR working heavy suburban traffic on the Great Indian Peninsula Railway in the Bombay area a series of tank engines of the 2-6-2 type, and fitted with Robinson superheaters, have been constructed by the Vulcan Foundry Co., Ltd. Cylinders are outside, 21 in. by 26 in., with piston valves operated by Walschaert motion. Leading and trailing wheels correspond, the former being carried by a bogie frame, while the latter have radial axle-boxes.



Photo] [*Fred. Bremner, Simla.*

THE INDIAN RAILWAY BOARD.

Standing: Mr. A. R. Anderson (Member, Railway Board).
Mr. R. W. Gillan, C.S.I., I.C.S. (Member, Railway Board).
Sitting: The Hon. W. H. Clark, C.M.G., C.S.I., Member, Viceroy's Executive Council for Commerce and Railways.
The Hon. Sir Henry Burt, K.C.I.E., V.D., President, Railway Board.

THE Grand Trunk Pacific Railway is building a large and extensive dry dock and shipbuilding plant at Prince Rupert. The dry dock will be capable of floating a 20,000 ton battleship. It is now expected that this dry dock and shipyard will be fully completed and machinery installed

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ready for any class of work which may be offered by January 1st, 1915.

* * *

In reference to Mr Whitton's articles entitled "From Antofagasta (Chile) to La Paz (Bolivia)," published in the September and October numbers of the Railway Magazine, the author writes from La Paz, asking us to give publicity to the fact that the majority of the photos illustrative of La Paz are the work of Mr. C. W. Glover. He points out also that Antofagasta reads as being the second "town" of importance in Chile: this should be "port"; whilst the journey time from Antofagasta to La Paz is now 43 hours, not 54, as stated in the article.

* * *

Five new 4-4-0 superheater engines of the "Scott" class have been completed at Cowlair's Works, North British Railway, as follows: No. 419, *The Talisman*; No. 420, *The Abbot*; No. 421, *Jingling Geordie*; No. 422, *Kenilworth*; No. 423, *Quentin Durward*.

* * *

The Queens Park Extension of the "Bakerloo" section of the London Electric Railway is to be opened for traffic on January 10th. This work was described in the December Railway Magazine. From Paddington the stations are: Warwick Avenue, Maida Vale, and Kilburn Park. At Queens Park connection is made with the suburban system of the London and North Western Railway. Owing to the station at Maida Vale not being in such an advanced stage of construction as are the others on the new line, it will not be utilised for traffic until a later date, so that on the inauguration of the extended service on January 10th the Bakerloo trains will run direct between Warwick Avenue and Kilburn Park.

* * *

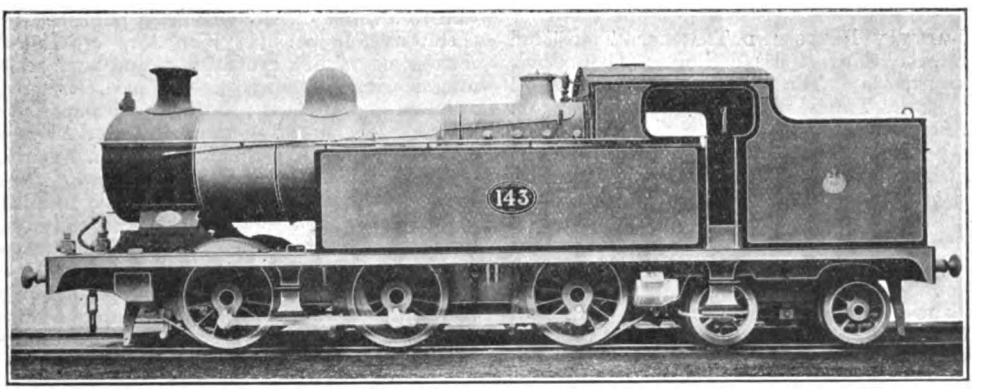
On December 11th restaurant cars were introduced on the trains between Calais and Boulogne and Paris, as well as on the night express from Paris to the Riviera.

* * *

On and after 1st January, 1915, the address of the Agent General for Western Australia will be "Savoy House," 115-116, Strand (Corner of Savoy Street), London, W.C.

0-6-4 TANK ENGINE: BARRY RAILWAY.

Designed by Mr. J. Auld, Locomotive Superintendent.



OWING to the heavy character of the traffic and the difficult gradients to be worked over, all the South Wales mineral-carrying railways call for powerful locomotives, and many of the engines in use are essentially modern in design and dimensions, though they may not be specially notable in respect of type and general features. In order to meet requirements on the Barry Railway, Mr. J. Auld has provided a further example of the use of the 0-6-4 type for powerful modern tank engines requiring considerable bunker capacity. The builders are Messrs. Hawthorn, Leslie & Co., Ltd., of Forth Banks Locomotive Works, Newcastle-on-Tyne. Leading dimensions are as follows:—

Cylinders	18½ in. x 26 in.
Diameter of coupled wheels	4 ft. 7 in.
,, ,, bogie ,,	3 ft. 1 in.
Heating surface—Tubes ..	1,372 sq. ft.
,, Firebox ..	123·5 ,,
,, Total ..	1,495·5 ,,
Grate area	22 sq. ft.
Working pressure ..	180 lb. per sq. in.
Capacity of tanks	2,200 gallons.
,, bunkers	4 tons
Weight in working order	78 tons 15 cwt. 1 qr.

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Railway Literature.

WITH SIGNALS CLEAR. By Ramsay Guthrie. [W. A. Hammond. Price, 2s. 6d. net.] It is not often that we have to refer to works of fiction among railway literature, and this volume, is only of railway interest insofar as its characters are almost exclusively railwaymen, and railway events and associations provide a setting rather than actual subject-matter. The book may, perhaps, be compared with Mr. Harold Begbie's "Broken Earthenware," in that it is a series of chapters, each more or less independent, dealing with religious work among the various railway scenes and typical railwaymen. The *venue* is but thinly disguised, Tynegate being manifestly intended for Gateshead, and in other respects North Eastern Railway geography is at once admitted. There is little ground for quibbling as to railway accuracy, direct references to railway practice being more or less incidental, so that the writer avoids most of the usual pitfalls by not going near them, though a few details may be questioned by the hyper-critical reader. However, there are some interesting characters, and the pictures given of Methodist religious work are most attractive, and we have experienced considerable pleasure in reading this volume.

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RAILWAY RATES AND TRAFFIC. Translated from the third (1907) edition of C. Colson's "Transports et Tarifs"; edited and arranged by Charles Travis, with an introduction by W. M. Acworth, M.A. [G. Bell & Sons. Price 3s. 6d. net.] This volume has been produced on the suggestion of the London School of Economics, and gives a series of short sketches of railway practice in various countries. Mons. Colson is a railway expert of high European standing. Part I. deals with the economic considerations which determine the cost of transportation; Part II., with railway rates in France; Part III., with rates in Europe and America; while Part IV. is devoted to the author's general conclusions.

OIL CONQUEST OF THE WORLD. By Frederick A. Talbot. [William Heinemann. 6s. net.] This is a further volume in the "Conquests of Science" series, of which Mr. Talbot has contributed those dealing with railways and steamships. The subject matter is presented in the usual comprehensive and interesting fashion, though the volume is designed more for general reading than as a treatise upon oil and its industrial importance. There are numerous illustrations, and much of the information will be fresh to those who have not studied the subject. Brief references are made to the use of oil on locomotive engines and its transportation by rail. The author is, however, not quite correct in his reference to "the late Mr. Holden," who is, though now advanced in years, still enjoying his well-earned retirement. It may also be pointed out that although oil fuel for locomotives offers many advantages, and from the economic point of view has much to commend it in suitable localities, the direct comparison with coal involves practical aspects which do not suggest themselves to the outsider.

* * *

MESSRS. JOHN BARTHOLOMEW & Co., of The Geographical Institute, Edinburgh, direct attention to a series of new war maps published by them, as follows: (1) *War Map of Central Europe*, containing general map and large scale map showing frontiers between France, Germany, Belgium and Holland; fortified cities specially marked. (2) *Large Scale Map of Central Europe*, embracing France, Germany, Belgium, Austria, etc. (3) *Special Contoured Map of North Eastern France, Belgium, and the Rhine*; scale 16 miles to an inch. This shows clearly all railways, fortresses, main and other roads, with distances specially marked; heights are also given. (4) *Orographical Map of Central Europe*, showing political boundaries. (5) *General Map of Europe and the Mediterranean*; scale 86 miles to the inch. Prices can be had on application.

RAILWAY TRAIN PHOTOGRAPHS.

In response to many appeals from RAILWAY MAGAZINE readers, a selection of the famous photographs by F. E. Mackay, of trains travelling at full speed is now obtainable in the form of post-cards. These cards are real photographs—not half-tone reproductions—and, as will be seen by the advertised list, the most economical method of purchase is by the dozen. Twelve cards are sent post free by the Railway Publishing Co., Ltd., 30, Fetter Lane, London, E.C., on receipt of two shillings. Special enlargements of any of F. E. Mackay's photographs, size 11 by 7 inches, on thin card, which obviates the necessity of mounting, can be supplied at the low price of 1s. 6d. each, post free, but enlargements are prepared to order only.

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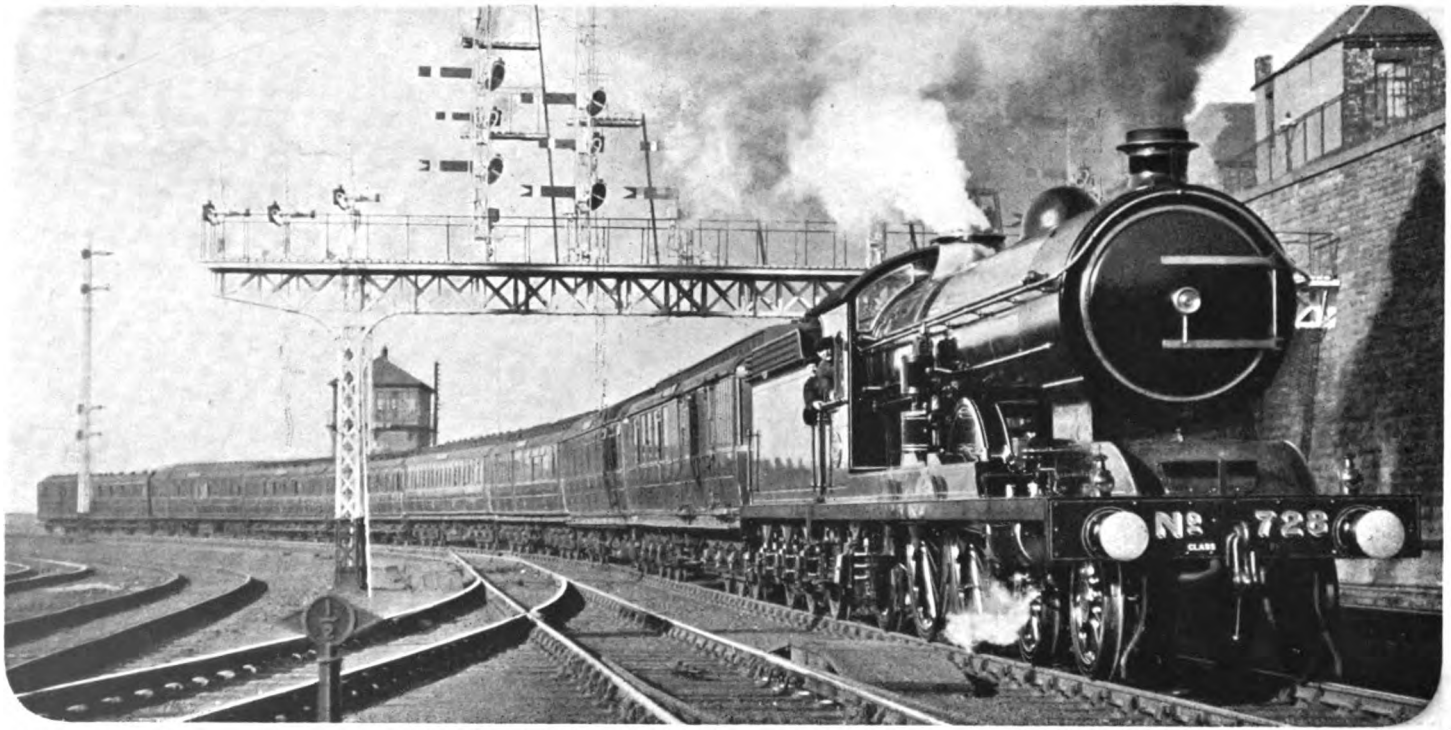

Photo] [*R. J. Purves.*

"SOUTHWARD BOUND"

Leaving King Edward Bridge, Newcastle-on-Tyne, for London (King's Cross).

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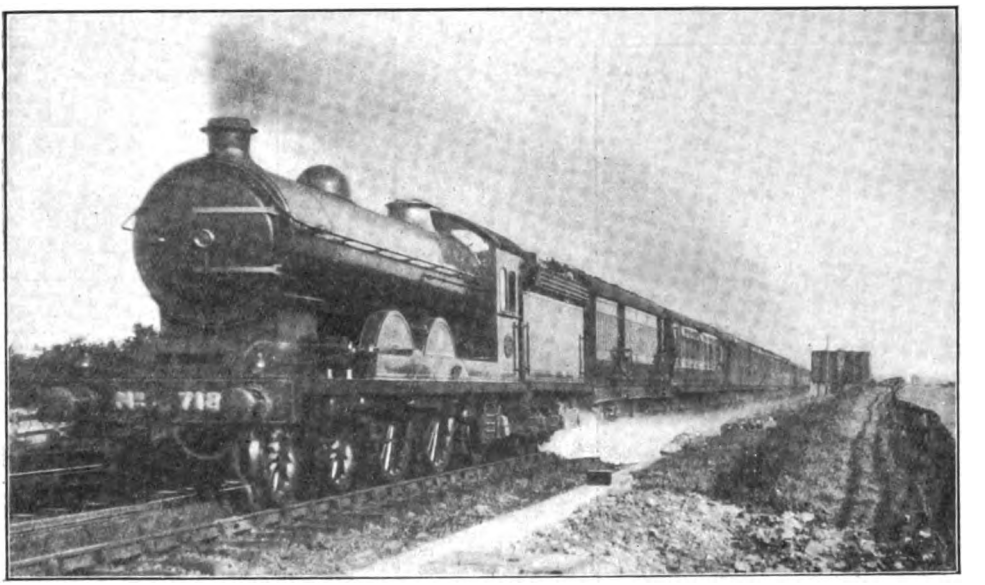

Photo] [*R. J. Purves.*

DOWN ANGLO-SCOTTISH EXPRESS (10 A.M. *ex*-KING'S CROSS) PICKING UP WATER AT THE TROUGHS NEAR BELFORD.

4–4–2 three-cylinder simple non-superheater locomotive No. 718.

Recent North Eastern Locomotives and their Work.

By J. F. GAIRNS.

IN June, 1910, an article was published in the RAILWAY MAGAZINE dealing with the Worsdell locomotives of the North Eastern Railway, the occasion being the retirement of Mr. Wilson Worsdell from active service as Chief Mechanical Engineer, and the appointment of Mr. Vincent L. Raven to succeed him. Even at that date, however, locomotive practice on this interesting railway had reached a high standard, for it must be remembered that Mr. Worsdell was responsible for the large-boilered 4–4–0 engines of the 1237 series (Class R1), together with the 6 ft. 1 in. and 6 ft. 8 in. 4–6–0 designs (Classes S and S1), the "Atlantics" of Class V, the four-cylinder compound 4–4–2's of Class 4CC, the 0–8–0 mineral engines of Classes T and T1, the 4–6–0 two-cylinder tank engines (Class W), and the 4–8–0 three-cylinder "hump" shunting tank engines of Class X.

During the years which have passed Mr. Raven has raised the standard of North Eastern locomotive practice still further, and largely on lines which are essentially distinct from those followed on other railways. He has not adopted the 4–6–0 type for high speed express traffic, as usual elsewhere, and the North Eastern Railway may be said to be the home of the "Atlantic" type in its highest and most interesting developments; and, by contrast with the practice of most other railways, the 4–6–0 wheel arrangement has become associated more particularly with engines intended for secondary and mixed traffic.

In boiler practice, too, the Raven *régime* has not involved the Belpaire firebox, though the boiler design adopted as a whole is a notable one. It is, however, in respect of the use of three non-compound cylinders that the engines are principally distinguished from those in use elsewhere, and in this respect Mr. Raven's practice is unique in conjunction with the fact that the casings for the three cylinders and three piston valve chambers are cast in one, though in most engines the motion is arranged on the "divided and balanced" principle. No 825,

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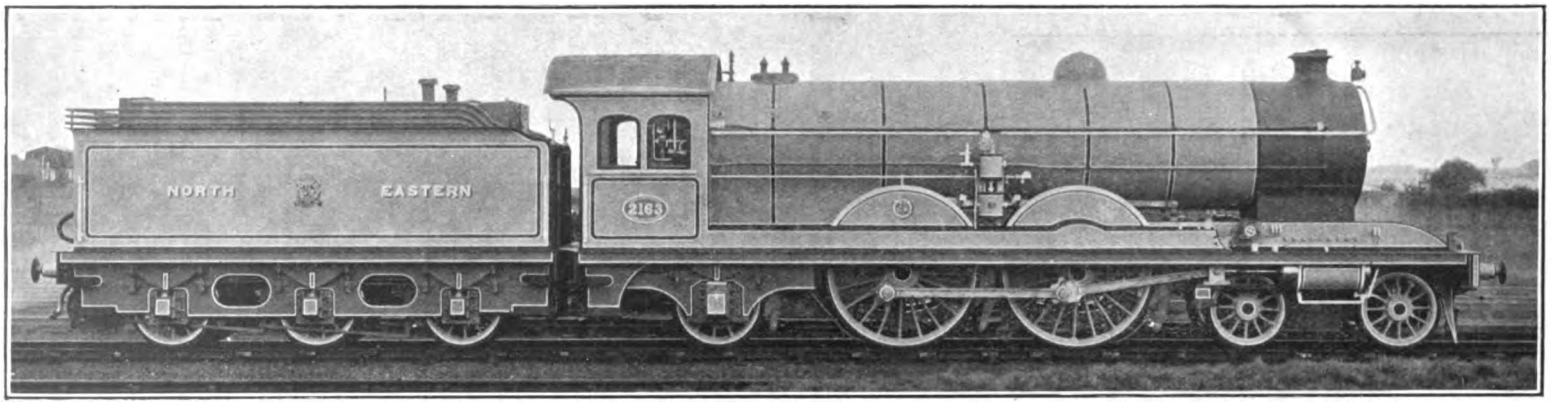

NEW CLASS Z THREE-CYLINDER SUPERHEATER EXPRESS LOCOMOTIVE NO. 2163.

LEADING DIMENSIONS OF LOCOMOTIVES DESIGNED BY MR. V. L. RAVEN.

Class.	Type.	Cylinders.	Coupled Wheels.	Grate Area.	Heating Surface (sq. ft.)				Adhesive Weight.		Total Weight Engine in Working Order.		Date.	No. of Engines.	Remarks.
					Tubes.	Firebox.	S'heater.	Total.							
		INS.	FT. IN.	SQ. FT.					T.	C.	T.	C.			
Z	4-4-2	16½ × 26 (3)	6 10	27	1798·9 1295·8	180 180	530·1 530·1	2509 2005·9	39	17	77	2	(20–1911) (10–1914)	30	20 under construction.
S2	4-6-0	20 × 26 (2)	6 1¼	23	1677	144	544·8	2365·8	43	6	70	14	—	19	
S2	4-6-0	20 × 26 (2) (Stumpf)	6 1¼	23	1677	144	544·8	2365·8	43	13	71	14	—	1	
T2	0-8-0	20 × 26 (2)	4 7¼	23	1226·2	144	544·8	1915	65	18	65	18	1913	30	20 under construction.
W (Rebuilds)	4-6-2T	19 × 26 (2)	5 1¼	23	1169·32	141	—	1310·32	43	6	78	0	(Rebuilt 1914)	1	(Remaining 9 engines to be rebuilt.
D	4-4-4T	16½ × 26 (3)	5 9	23	934·84	124	273	1331·84	39	14	84	15	1913–1914	20	10 under construction.
Y	4-6-2T	16½ × 26 (3)	4 7½	23	1508	140	—	1648	55	12	87	8	1910–1911	20	

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of the 4–6–0 mixed traffic class, is further remarkable in that it has Stumpf " uni-flow " cylinders, but although good results are claimed, no further engines have been constructed so equipped. This engine also has Walschaert valve gear, virtually as a matter of necessity, and is the only one on the line thus fitted. In developing the three-cylinder system Mr. Raven has introduced remarkable 4–6–2 and 4–4–4 tank engines including this feature.

To some extent to deal with these designs is to re-tell a familiar story; at the same time there is much of interest in reference to these locomotives which is well worthy of reference, and in conjunction with other remarks it is thought that this further study will justify itself. The first of the three-cylinder " Atlantics " came out in 1911, ten being constructed with 15½ in. cylinders and using saturated steam, and ten with 16½ in. cylinders and Schmidt superheaters. These were known respectively as the Z and Z1 classes. Both attained a special reputation, though the most remarkable run within the writer's experience was given by one of the non-superheated series. But the honours undoubtedly rest with the superheated engines, and some of Class Z engines have since been fitted with superheaters, while further engines built last year include that equipment. All the non-superheater engines have been, or are being fitted with superheaters, and both these classes, as also the newer ones built last year, and others now in hand, are known generically as Class Z.

By the courtesy of Mr. V. L. Raven the following detailed particulars of this interesting class can be given as follows :—

LIST OF CLASS Z LOCOMOTIVES.

Originally non-Superheater : Nos. 706, 709, 710, 714, 716, 717, 718, 719, 720, 721.

Original Series of Superheater Engines : Nos. 722, 727, 728, 729, 732, 733, 734, 735, 736, 737.

1914 *Series of Superheater Engines :* Nos. 2163 to 2172.

New Series of Superheater Engines : Nos. 2193 to 2212. Of this batch three are built, remainder in hand.

These engines are confined to the main line, generally from York, but occasionally from Doncaster, to Newcastle and thence to Berwick and over the North British Railway to Edinburgh; but there is more than sufficient scope for them on that section, where many notable performances to their credit are on record, not only in respect of fast running, but also in conjunction with exceptionally heavy as well as normally heavy loads. It has to be remembered, too, that while the Doncaster-York section is substantially level, and the York-Darlington section constitutes the racing ground of the North Eastern Railway, the gradients are difficult between Darlington and Durham, while north of Newcastle is far from easy for many miles, and the engine working includes negotiating the severe gradients of the North British section. In conjunction with the fact that the loads of Anglo-Scottish East Coast trains are almost invariably considerable, 250 tons being about the minimum, and usually much in excess of this, the maintenance of schedules averaging 50–56 miles an hour is no easy task, even for these big engines.

The North Eastern Railway is peculiar in that while it is one of the lines utilising the 4–6–0 design, the engines of this class are more particularly intended for mixed traffic, though in practice they do a fair amount of express passenger traffic, frequently on the basis of passenger working one way and express goods the other. Indeed, the original 4–6–0 engines of Classes S (6 ft. wheels) and S1 (6 ft. 8 in. wheels) are now allocated in this way, while subsequent Class S engines, together with the corresponding Class S2 (fitted with superheating apparatus, and now including some of the older engines similarly equipped) have always been classified in this way. On this basis they are frequently employed for working fish and vacuum-fitted express goods trains, many of which are timed fairly fast, while as the engines can go almost anywhere, including the Hull, Bridlington, Scarborough, and the Stockton, Hartlepool, and Sunderland routes, they constitute generally useful engines for heavier duties of all kinds.

The most interesting engine of this class is No. 825, which is fitted, as already mentioned, with Stumpf " uni-flow " cylinders, giving it a peculiar and unique appearance. The class, as a whole, with the older engines now co-ordinated therewith, is, however, a numerous one, and is probably the most generally useful, except for lighter duties, on the line. The following engines are included in Class S2 :—Nos. 782, 786, 787, 788, 791, 795, 796, 797, 798, 799, 813, 815, 817, 819, 820, 821, 822, 823, 824, 825 (Stumpf).

For mineral traffic the 0–8–0 superheater engines constitute a natural development of the T and T1 series previously in use, and there is not much of special importance to record concerning them.

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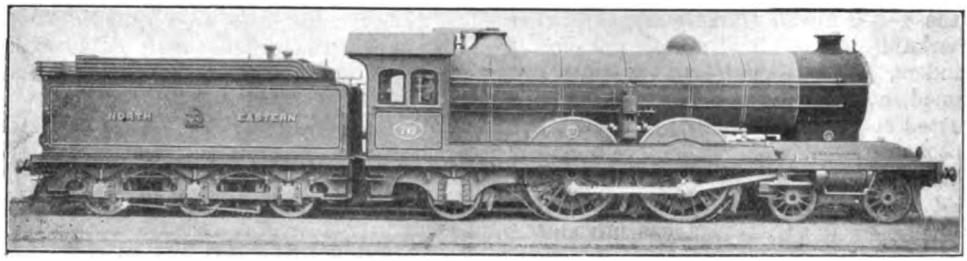


ORIGINAL NON-SUPERHEATER THREE-CYLINDER 4-4-2 LOCOMOTIVE NO. 717.

As regards tank engines, however, two remarkable classes call for attention. The 4-6-2 three-cylinder engines of Class Y are used for local goods traffic calling for considerable power capacity, mainly between York, Normanton and Selby, Normanton and Leeds, and Leeds and Starbeck. They are, in fact, adaptations of the 4-6-0 tank engines of Class W, but with three cylinders, and including features derived from the 4-8-0 three-cylinder " hump " shunting engines of Class X.

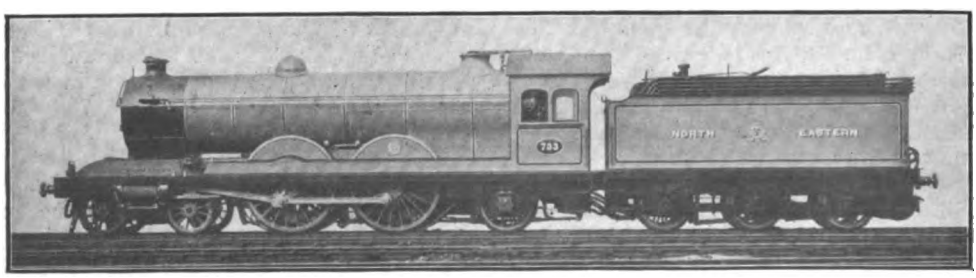
The other design is that of the 4-4-4 three-cylinder Class D passenger tank engines, combining large bunker capacity and adaptability for fairly lengthy and fast runs, with suitability for heavy branch line traffic. They are, indeed, the most remarkable 4-4-4 tank engines in the United Kingdom, and their work is far different from that given to the other engines of that type in use elsewhere. So far there are twenty of this class in service, working mainly on the Newcastle-Middlesbrough expresses *viâ* the Coast line, Newcastle and Blackhill, Darlington and Saltburn, and York—Pickering and Scarborough routes.

Besides these special designs many of the older engines have been fitted with either Schmidt or Robinson superheaters, and it is worthy of note that in many cases Mr. Raven has done away with damper mechanism, using instead a steam circulating system to protect the elements while the steam is shut off.

As already indicated the principal duties given to the 4-4-2 locomotives are between Doncaster or York and Newcastle and between Newcastle and Edinburgh, but even this limitation gives a distance of 237 miles over which they are the principal engines in service, the former section being plentifully served by express trains, and the latter including a dozen or so runs each way daily on which these locomotives may be employed. In practice other engines take a share in possible duties, and occasionally as alternatives to the " Atlantics " ; but that does not alter the fact that here is their special sphere of work, and these are the trains in view of which they were specially designed.

It will be interesting to see how many suitable trains are thus involved, necessarily on the basis of summer facilities, when the duplication of most of the Anglo-Scottish trains becomes an important factor in the number of engines required in service. Although the Scottish trains are not the fastest on the York-Newcastle section, they are uniformly characterised by considerable loads, about 250 tons being the minimum, while 375 tons is a standard summer load on certain trains, often increased by 50 tons or so.

Now no Anglo-Scottish train passes York without calling, that stop having been reinserted into the schedule of the 9.50 a.m. relief to the 10 a.m. *ex*-King's Cross two or three years ago, though a North Eastern



ORIGINAL SUPERHEATER THREE-CYLINDER 4-4-2 LOCOMOTIVE NO. 733.

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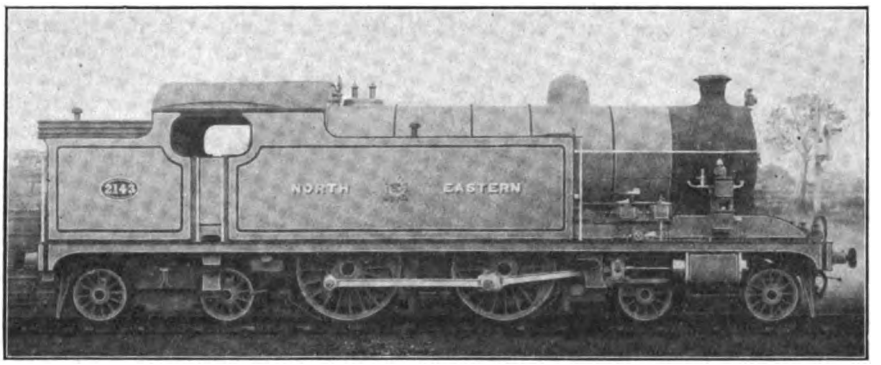
engine continued to take that train on from Doncaster instead of York, this practice having only recently been discontinued. There is, however, no need to consider specially the Doncaster-York section, not exactly easy, but still hardly notable on account of the locomotive work involved over it.

Between York and Darlington the road is also fairly easy for northbound trains, though harder than in the opposite direction owing to its gradual rising tendency. Beyond Darlington is distinctly difficult, though down trains have the easier task, while the fact that careful running is called for at several places, causes the maintenance of really high average speeds to be more or less out of the question if the load is considerable as it usually is.

Principal interest attaches first to the series of night sleeping car trains from London, commencing with the 11.37 p.m. (7.55 p.m. Highland Express from King's Cross), booked to cover the 80 miles from York to Newcastle (Central) in 90 min. This becomes a hard run, and in practice Darlington (44¼ miles) must be passed in 47 or 48 min. so as to leave 44 or 43 min. for the 36 miles thence to Newcastle in view of the Durham slack, careful running elsewhere, and the approach to Newcastle. Next comes the 11.57 p.m. from York (8.15 p.m. *ex*-King's Cross) allowed one minute longer, and frequently a heavier train. At 1.14 a.m. the continuation of the 8.45 p.m. from London leaves York, booked in 52 min. to a stop at Darlington, and allowed 47 min. for the journey thence to Newcastle, an apparently easy schedule, but not altogether so in practice as this generally useful train becomes really heavy at times.

The two midnight expresses from London (11.30 and 11.45 p.m. *ex*-King's Cross) are both booked non-stop from York to Newcastle, one in 91 and the other in 93 min., again calling for good work. The former of these is the only one of which the writer has a detailed record, behind one of the three-cylinder "Atlantics," in that case with No. 729 (Class Z1, superheater), load 5 twelve-wheelers and 3 eight-wheelers, about 270 tons.

On that occasion Thirsk (22¼ miles) was passed in 24¾ min., and Darlington (44¼ miles) in 46¼ min. Near Ferryhill a bad check was experienced, but that station was passed in 16¾ min. from Darlington (12¾ miles), and Durham 10 min. 5 sec. later (9 miles), while the final 14 miles were covered in 19 min. 20 sec. owing to a series of checks, causing the complete run to occupy 92 min. 50 sec., instead of 91 min. This run, while not notable for load, is a good example of the relative ease with which



CLASS D. THREE-CYLINDER SUPERHEATER 4-4-4 TANK ENGINE NO. 2143.

these engines appear to do their work, especially as the load would have been considerable for a smaller engine.

Then follows a sequence of trains on other services, constituting secondary expresses, the next of special interest being the 9.38 a.m. from York (8.55 a.m. *ex*-Leeds) which for a long period had the distinction of being the fastest on this section. Even now it is only allowed 89 min. to Newcastle, and its continuation northwards is the fastest on the Newcastle-Edinburgh route. It is worthy of notice as being essentially a Leeds-Edinburgh-Glasgow restaurant car express, and except for the fact that it connects with the 5.5 a.m. newspaper train from London, has little to do with London traffic, being thereby differentiated from all other principal East Coast Anglo-Scottish trains. It consists of North Eastern rolling stock only, and although for a long period a light train is now

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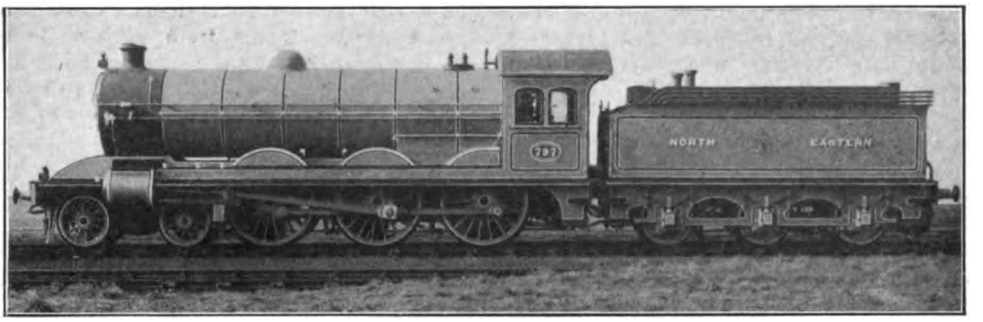


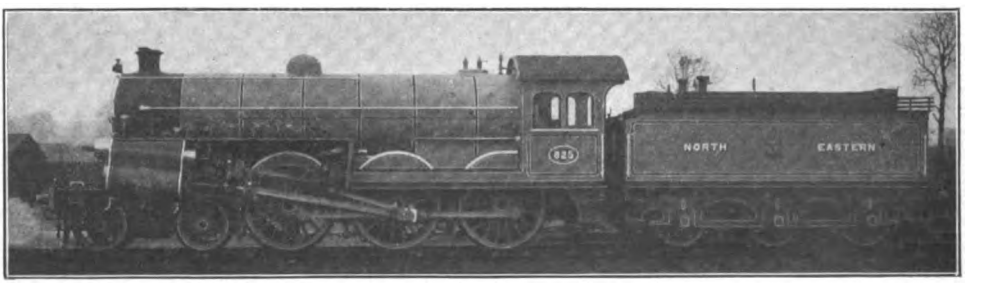
CLASS S2 SUPERHEATER MIXED-TRAFFIC 4-6-0 LOCOMOTIVE NO. 797.

becoming fairly heavy, this being partly the reason for its deceleration from the one-time schedule of 84 min. York to Newcastle. The writer had a run with this train some years ago upon its fast schedule, but that was with a 4-4-0 R class engine. It is often, by the way, still worked by the smaller engines, though a big one generally takes the train northwards, with a heavier load.

The 9.57 a.m. from York is a secondary express, though it is an Anglo-Scottish train, while the 12.40 p.m. does not call for special notice, though both are timed fairly smartly between stops. At 1.42 p.m. the relief morning Scotchman leaves York, frequently with a really heavy load, and rarely under 300 tons. It is, however, allowed 96 min. to Newcastle; and the following train (the 10 a.m. *ex*-King's Cross, the morning Scotchman proper) is allowed 99 min., largely owing to the fact that it is liable to be the heaviest of the whole series.

A run on the latter train, behind No. 733 of the superheater 3-cylinder 4-4-2 class, may here be referred to, the load from London being 350 tons, and another 8-wheeler being added with the North Eastern engine at York. On that occasion Thirsk (22¼ miles) was passed in 28¼ min., Northallerton (30 miles) in 36 min. 35 sec., and Darlington in 51 min. 35 sec. Beyond, a slight check was experienced, but the 12¾ miles to Ferryhill were covered in 16 min. 10 sec. The dip to Croxdale assisted the sharp ascent beyond, so that the 9 miles to Durham occupied only 9 min. 50 sec., and the 14 miles thence to Newcastle occupied 17 min., so that eventually the run was completed in 94½ min. against 99 allowed, and virtually bringing the train on to time again, a few minutes having been lost south of York. This was really a notable run and is worthy of attention in view of the load taken.

The 2.5 p.m. from York is one of the Lancashire and Yorkshire and North Eastern joint Liverpool-Newcastle expresses, formed on alternate days of special rolling stock provided by the respective companies. It is by no means a light train, though probably not often over about 250 tons, but is scheduled to Darlington in 45 min. only (44¼ miles), while its booking of 54 min. thence to Newcastle allows of a set-down call at Durham if required. The writer has no record of this train north of York, though he has travelled several times by it on the Lancashire and Yorkshire section, but it is seldom referred to as providing a companion booking to that of the 9.13 p.m. from York, which also is allowed only 45 min. to Darlington.



CLASS S2 SUPERHEATER MIXED-TRAFFIC 4-6-0 LOCOMOTIVE NO. 825
(Fitted with Stumpf "uni-flow" cylinders.)

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As the 11.20 a.m. *ex*-King's Cross travels *viâ* Harrogate it operates over only a portion of the route under notice, but it may be pointed out that although a heavy train, often worked by the big engines under consideration, it is allowed only 46 min. from Darlington to Newcastle. The 3.30 p.m. (10.35 a.m. from King's Cross, another generally-useful Anglo-Scottish express) has the somewhat liberal allowance of 55 min. to Darlington. The 5.7 p.m. (the Great Central Barry-Cardiff-Newcastle train) is timed very smartly to Northallerton in 34 min. (30 miles). To Darlington 18 min. are allowed (14¼ miles), while for the Darlington-Durham section the train is scheduled in 26 min. (22 miles, rather difficult).

At 6.8 p.m. the dining car express which connects with the 1.40 p.m. from King's Cross forms a relief to the 2.20 p.m. from London, though its main importance is to connect Liverpool, Manchester, Sheffield, Leeds, etc., with Newcastle. It is allowed 52 min. to Darlington, and 51 min. thence to Newcastle, as in the case of the 6.15 p.m. itself (2.20 p.m. *ex*-King's Cross). When running late this train is expected to cover the York-Darlington section in 50 min. Here also weight is a factor conducing to somewhat easier schedules.

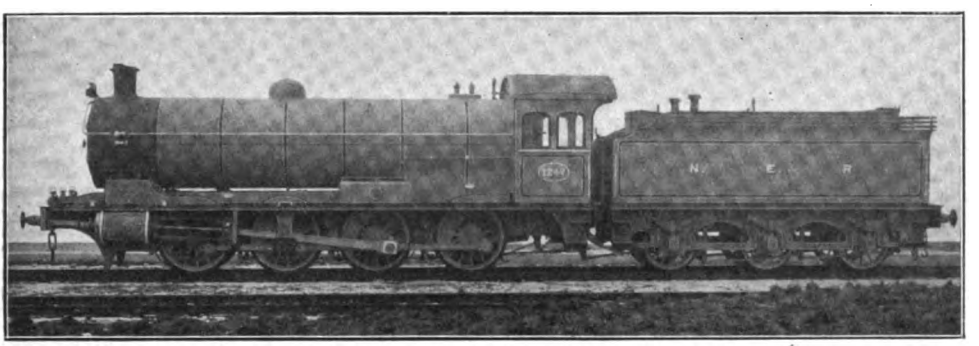
Then at 9.13 p.m. is another very tightly-timed express, off the 5.30 p.m. *ex*-King's Cross, booked, as already mentioned, in 45 min. only to Darlington, while thence to Durham only 26 min. are allowed. This is followed by the Saltburn section, allowed 34 min. for the 30 miles to Northallerton, though this is usually only light.

There are also several other secondary expresses, calling at Thirsk, Northallerton, Darlington and Durham, or two or three of these stations, besides trains which run *viâ* Stockton and Sunderland, or direct from Leeds avoiding York; but the majority of these are timed fairly moderately, though in many instances smartly on particular sections, besides which they are not usually taken by the big engines under notice.

On Sundays the 2.30 p.m. Edinburgh train may be noted, though it is given the liberal allowance of 105 min. from York to Newcastle, non-stop; together with the 10.5 p.m., 51 min. to Darlington and calling thence at Durham only to Newcastle.

In the opposite direction the 1.25 and 1.42 a.m. sleeping car trains from Newcastle may first be noted, both important Anglo-Scottish south-bound expresses, and both allowed 96 min. to York, non-stop. The Highland train from Newcastle at 1.52 a.m. calls at Darlington, and is allowed 47 min. for the first run and the smart timing of 48 min. thence to York.

In the ordinary day's work there are several good trains from Newcastle before the day Anglo-Scottish expresses come under consideration. The 8 a.m. is an important breakfast and luncheon car express, corresponding to the 5.30 p.m. down *ex*-King's Cross. It is booked from Newcastle to Darlington in 48 min., including a 2-min. stop at Durham, and from Darlington to York in 47 min., average 56·4 miles per hour. Other trains of a secondary character include the 7.52 a.m., 8.43 (Leeds) a.m. and 9.20 a.m. The 10.28 a.m., the continuation of the 7.45 a.m. from Edinburgh, is allowed 97 min. to York, but this may include a conditional stop at Darlington. The 12.20 p.m. is fairly light, and is bound principally for Sheffield. On its merits it is merely a good train from Newcastle to Sheffield, but is mainly notable because its schedule of 43 min. from Darlington to York gives it the distinction of being the fastest train in the United Kingdom. It is, however, usually worked by a



CLASS T2 SUPERHEATER 0-8-0 LOCOMOTIVE.

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smaller engine, though the big ones have on several occasions distinguished themselves in working it on schedule or two or three minutes faster. The writer's own experiences have, however, always been with Class R locomotives.

Following this is the 12.30 Liverpool and Manchester train (Lancashire and Yorkshire route), generally taken by a mixed traffic 4–6–0, and sometimes by the Stumpf engine No. 825. This is allowed 45 min. to Darlington, and 51½ min. thence. Then at 12.39 p.m. the first morning Scotchman (10 a.m. from Edinburgh) is due to leave, non-stop to York in 98 min., followed by the 12.50 p.m., the second portion, calling at Darlington, but actually slightly faster as its allowance there is 6 min. and yet is due to reach York in 102 min. During July, August and September, 1913, the former was worked every day by an engine of Class Z, and on no occasion was time lost by the engine, though the average loads for the respective months between Edinburgh and Newcastle were 274, 282 and 290 tons, and the maximum loads 358, 350 and 330 tons; while from Newcastle to the south the loads were: average, 276, 286 and 301 tons, and maximum, 358, 350 and 359 tons.

At 3.17 p.m. the 12.25 p.m. from Edinburgh leaves for the south *viâ* Harrogate, booked in 45 min. to Darlington, and at 4.40 p.m. the 2 p.m. from Waverley is due to depart, having the unusual schedule of 61 min. to Northallerton (50¼ miles) and 34 min. thence to York.

With this train the writer had an interesting run behind No. 823, a 4–6–0 (6 ft. class) mixed traffic, the load consisting of three East Coast Joint Stock twelve-wheelers, four East Coast Joint Stock eight-wheelers, and two Lancashire and Yorkshire ordinary bogie coaches. Durham was passed in 20½ min., and with a bad check near Ferryhill and another near Aycliffe, Darlington was passed in 46 min., and Northallerton was reached in barely 64 min., a loss of three minutes, owing to the checks mentioned. Here the Stockton through coach was added. On the final stage, however, the excess of 40 sec. over the allowance of 34 min. was due entirely to a very slow run into York, and right to the south end of the platform.

The second portion of this train at 5.6 p.m. is allowed 45 min. to Darlington and 48 min. for the run thence to York. With this train the writer had an experience from Darlington to York with about 350 tons, taken by a superheater 4–4–2 in a blinding snowstorm. The record is not available, but his recollection is that the run was covered in only 1 min. over time.

At 9.14 p.m. the special Glasgow-Leeds express leaves Newcastle, but is slower on this stage than the northbound train, being allowed 52 min. to Darlington and 49 min. thence to York. On Sundays the most interesting train is the 3 p.m., booked in 48 min. to Darlington and 51 min. thence to York.

The trains noted far from exhaust the record of express working on the main line south of Newcastle, but include virtually all the more notable schedules, which do or may fall to the lot of the large main line locomotive classes, frequently, and sometimes normally, with considerable or really heavy loads.

North of Newcastle there are fewer trains, but nearly all the more interesting trains call for special remark, and in many ways the writer is of the opinion that the most remarkable locomotive work performed by North Eastern locomotives is there to be met with.

On this section there are continual up or down grades, but it is not until Alnmouth is passed that the Longhoughton bank (4 miles at 1 in 170) for northbound trains and Christon Bank—to use the name provided by the station near its foot—of 3 miles at 1 in 150 for southbound trains, call for specially difficult work. Near Scremerston there is a stretch at 1 in 190, but it is north of Berwick, on the North British Railway, that the real difficulties of the route are met with, the Burnmouth (4⅓ miles at 1 in 190) and Grant's House bank of virtually 6 miles at 1 in 200 for down trains, and the Cockburnspath bank of 4 miles at 1 in 96, for up trains. In winter very few trains pass Berwick without calling, but in summer, when the principal trains are operated in duplicate, the usual arrangement is for one to call there and the other to pass the border station, necessarily at reduced speed, owing to the bridge and the location. Most of the Anglo-Scottish trains make the clear run between Newcastle and Berwick, but a few of the secondary trains, such as those before referred to as of the "generally-useful" order (10.35 a.m. *ex*-King's Cross, for example) make one or more calls on North British territory, even if worked by a North Eastern locomotive.

Still adopting the summer time tables as

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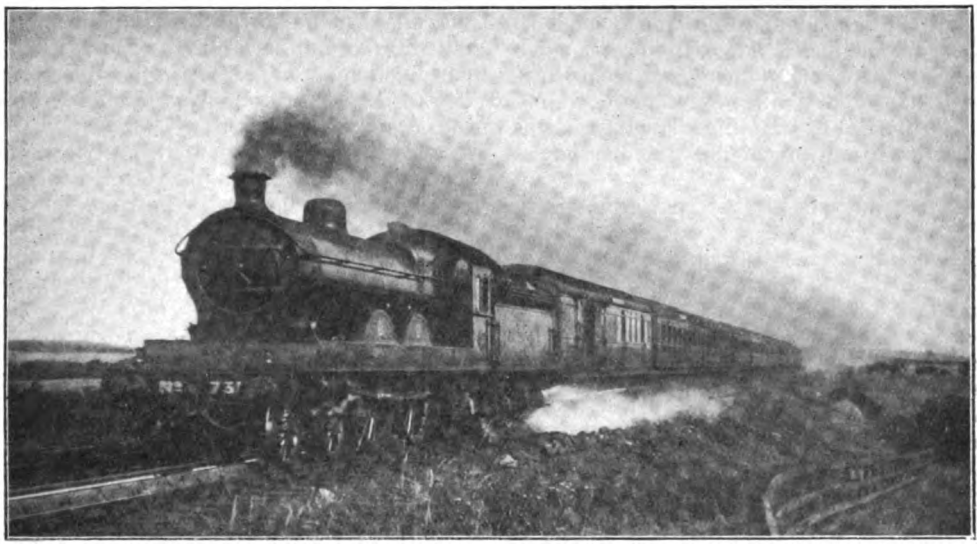
a basis, virtually as a matter of necessity to realise the work to be done by the principal North Eastern locomotives, the first train does not figure on this section in Bradshaw at all, though it is given from York, as that station constitutes its last picking-up station. Onwards it calls only for traffic purposes at Newcastle and Edinburgh, *en route* for Perth and the Highland Railway. It is booked to leave Newcastle at 1.12 a.m., and pass Berwick at 2.24 a.m., that is, the 67 miles are due to be covered in 72 min., while the remaining 57½ miles to Waverley are scheduled in 68 min., the allowance for the complete run of 124½ miles thus being 140 min. The following train, the 8.15 p.m. from London, is booked from Newcastle at 1.33 a.m., and passes Berwick at 2.48 a.m. (75 min.), and reaches Waverley at 3.55 a.m., 67 min. from Berwick, and 142 min. for the complete run. Both these schedules call for notable work, and usually the large "Atlantics" are employed, the load of the former train being generally at least 250 tons and of the latter somewhat heavier.

The 8.45 p.m. from King's Cross calls at Morpeth and Alnmouth to leave mail bags, and is booked in 88 min. on the first section and in 70 min. on the latter, but the 11.30 and 11.45 p.m. trains from King's Cross reintroduce the harder schedules, the former being timed to pass Berwick in 75 min. and the latter in 73 min., while the times on the Berwick-Edinburgh stage in both cases are 67 min.

With the former train, taken by No. 709, one of the non-superheater three-cylinder "Atlantics" of class Z, the writer had the most sensational run he has ever recorded on the North Eastern Railway, but, unfortunately, an element of doubt has arisen which neutralises the value of the record. However, the net result appears to be beyond question that Berwick was passed in 70¾ min. from Newcastle (67 miles), and that the 57¾ miles thence to Waverley occupied 67¾ min., with relatively mediocre work over the first 20 miles or so and down the Cockburnspath bank, while the approach to Edinburgh involved slow running for the last two or three miles. It was on certain intervening sections that the running appeared to be so exceptional, but the most careful examination and comparison has not revealed the real facts, at least satisfactorily. The load consisted of five twelve-wheeled and three eight-wheeled East Coast Joint Stock vehicles.

The next express of special interest is the 11.14 a.m. *ex*-Newcastle, which has the distinction of the fastest timing for the non-stop run to Edinburgh, 138 min. for the 124½ miles. This North Eastern train is timed to pass Berwick in 71 min., with 67 min. for the run to Edinburgh. The writer's only



Photo] [*R. J. Purves.*

DOWN ANGLO-SCOTTISH EXPRESS (9.50 A.M. *ex*-KING'S CROSS) PICKING UP WATER AT THE TROUGHS NEAR BELFORD.

4–4–2 four-cylinder compound locomotive No. 731.

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experience with this train was also with a non-superheater three-cylinder "Atlantic," No. 703, load 6 heavy bogie cars, two of them diners. On this occasion the 34¾ miles to Alnmouth occupied 40 min. 10 sec., and the remaining 32¼ miles to Berwick exactly 30 min., while with one check near Joppa the time into Waverley thence was just 10 sec. under 67 min.

The two portions of the morning service from London involve in the one case a non-stop run at 3.26 p.m. from Newcastle (81 min. to Berwick, thence 73 min.), while the 3.39 p.m. from Newcastle calls at Berwick at 4.58 p.m. (79 min.), and is allowed 72 min. for the final stage Both are heavy trains timed somewhat moderately for that reason. With the second of these trains, load 375 tons, taken by No. 729, superheater three-cylinder "Atlantic," the writer recorded 81 min. 40 sec. for the run to Berwick, and 73 min. 15 sec. on the final stage, a slight, though virtually negligible, loss of about a minute.

In the case of the 11.20 a.m. from King's Cross the allowance from Newcastle to Berwick, start to stop, is 77 min., while in Scotland calls are made at Dunbar and Drem, so that 85 min. are occupied to Edinburgh, but with the continuation of the 2.20 p.m. *ex*-King's Cross a run to Berwick is given in 78 min., and of 73 min. thence to Waverley. These runs, again, are good, but do not represent the best work given to the large North Eastern "Atlantics" except on the basis of load. In the case of the Sunday 4.25 p.m. express from Newcastle, 83 min. are allowed to Berwick and 79 min. thence to Edinburgh, with a call at Dunbar.

It may be noted here that some of the times mentioned do not accord exactly with those published, owing to the common practice of scheduling arrivals at Waverley 5 min. in advance, though a train is reckoned to keep time if the published arrival is maintained.

In the opposite direction the first train of interest is the 7.45 a.m. from Waverley, To Dunbar it is allowed 37 min. (29¼ miles), and 35 min. for the run thence to Berwick, 28¼ miles, including the Cockburnspath bank. Starting from Berwick, it is scheduled to Newcastle in 74 min. The writer's own experience commenced at Berwick, behind No. 730, one of the four-cylinder compound "Atlantics," but the load only about 200 tons, and the time taken 72 min. 35 sec. to the stop at Newcastle.

Of the two portions of the principal morning service from Edinburgh to London, the 10 a.m. calls at Berwick when required at 11.11 (71 min.), and is allowed 78 min. thence to Newcastle, while the 10.10 a.m., really 10.15 a.m., is due to make the complete run in 149 min. With No. 735 (superheater three-cylinder "Atlantic") and 270 tons on the former train, the first stage was covered in 69¾ min., a gain on time, but for some reason no less than 8¾ min. were spent at Berwick, instead of 2 min. This loss was not, however, picked up, partly owing to delays approaching Newcastle, the run thence taking, however, only 78½ min. notwithstanding.

In the case of the 12.25 p.m. express from Waverley, with calls at Drem and Dunbar, the run from Berwick to Newcastle is scheduled again in 78 min., and this applies also to the 2 p.m. from Waverley, following the 70-minute booking to Berwick. The second portion, 2.30 p.m. from Waverley (publicly booked 2.20 p.m.) is timed to pass Berwick in 70 min., with 78 min. for the following stage. With the first portion, taken by No. 732 (superheater three-cylinder 4-4-2) and a bad check near Prestonpans, Berwick was reached in 68¼ min., while the Berwick-Newcastle section was covered with ease in exactly the 78 min. allowed. The load was about 275 tons, but was taken in the times noted with extremely noticeable ease.

The next train of interest is that leaving Edinburgh at 6.25 p.m., the return special Leeds train previously referred to. It is booked in 71 min. to Berwick. The writer's only experience with this train was behind No. 698, an ordinary "Atlantic," with a load of 7 bogies and 2 diners, or about 270 tons. On that occasion the actual time occupied was 50 sec. over the 71 min., owing to an easy approach to Berwick, where the journey was terminated. Onwards to Newcastle this train is allowed 79 min.

There remain only the night up Scotch expresses, which on this section necessarily call for attention at the close of the day's record, though elsewhere they have ranked among the early morning trains. There are three principal trains in the full service. The 10.35 p.m. is primarily a Perth and Edinburgh sleeping car express, and is peculiar in that it calls conditionally at Drem (26 min. for 17¾ miles), and is thence allowed 51 min. to Berwick (40 miles). The 10.50 (actually 10.55) p.m. is a sleeping car train from Montrose, Fort William, Dundee, etc., and

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calls at Dunbar at 11.35, and at Berwick when the 10.35 p.m. from Edinburgh is not running, its passing or departure time at Berwick (12.16 a.m.) leaving 79 min. for the run to Newcastle. The 11.15 p.m. is the Inverness, Aberdeen and Dundee sleeping car train, and is booked to pass Berwick in 72 min., with 78 min. allowed thence to Newcastle.

On Sundays the 12 noon express from Edinburgh may be noted, booked to Dunbar in 39 min., and to reach Berwick in 82 min., while 81 min. are allowed for the run from Berwick to Newcastle.

In addition to trains noted several conditional runs of empty stock are made during the summer, and these are timed fairly fast, though slower than the expresses, and one or two horsebox and carriage truck trains are also booked smartly, and these, together with certain semi-fast trains, such as the 10.25 a.m., 2.50 p.m., and 7.45 p.m. from Edinburgh, with a share in special fish and express goods trains, add further to the duties which may fall to the North Eastern large locomotives.

There is neither need nor scope for dealing with the general express services worked by North Eastern locomotives, apart from those of the direct main line, especially as the large "Atlantics" rarely work on other routes and the bulk of the work is performed by smaller engines—these also do much meritorious work on the main routes, but that is outside our present subject—except that the 4–6–0 mixed traffic engines may take a more or less important share therein. However, this review of the principal duties which fall to the lot of the more notable engines, in conjunction with the gradients, and frequently really heavy loads to be conveyed, affords a good indication of what is required of the larger and more interesting locomotives of this important northern railway.

In conclusion it may be mentioned that the totals of the special types referred to now in use are:

4–4–2, two-cylinder	20
4–4–2, compound	2
4–4–2, three-cylinder	30
(and 20 building)	
4–6–0, 6 ft. 8 in. wheels	5
4–6–0, 6 ft. 1 in. wheels	60
4–4–4 T, three-cylinder	20
(and 10 building)	
4–6–0 T (these are being rebuilt) ..	10
4–6–2 T, three-cylinder	20
4–8–0 T, three-cylinder	10

The writer has to acknowledge the courteous assistance of Mr. V. L. Raven and his staff in revising the proofs and in supplying additional information included above.

———

In conclusion, reference may be made to the Lockyer regulator, designed by Mr. Norman Lockyer, Works Manager at Darlington, and which is fitted to the new Class Z locomotives, as well as to many other North Eastern locomotives.

CLASS Y. THREE-CYLINDER 4–6–2 TANK ENGINE NO. 1113.

In double beat regulator valves, as usually designed for locomotives, the valve is in one piece and rests when closed on double seats in the valve chest, or head, thus necessitating the lower valve being of smaller diameter than the upper in order to enable the valve to be placed in position. This difference in diameter represents an unbalanced area, the pressure of steam on which has to be overcome before the valve can be opened. It is also usual in valves of this description to have a large opening in proportion to the lift, an objectionable feature when applied to locomotives since careful regulation of the steam is very necessary when putting a locomotive into motion, more particularly in the running sheds.

To obtain the good qualities of easy opening and complete control of the steam

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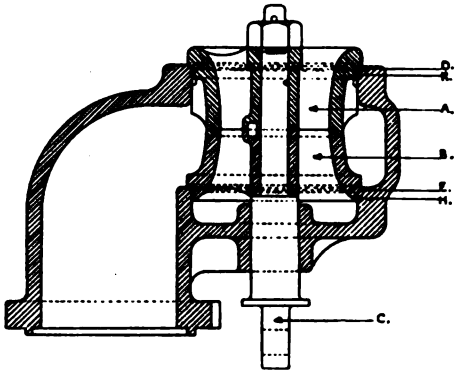


FIG 1.

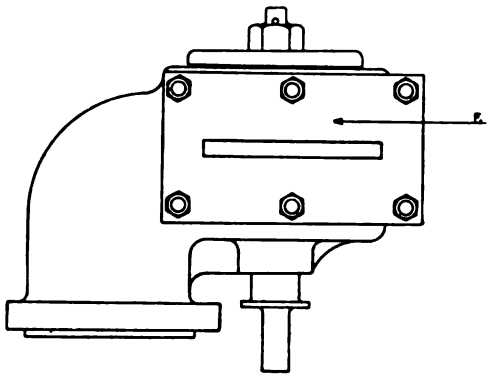


FIG 2.

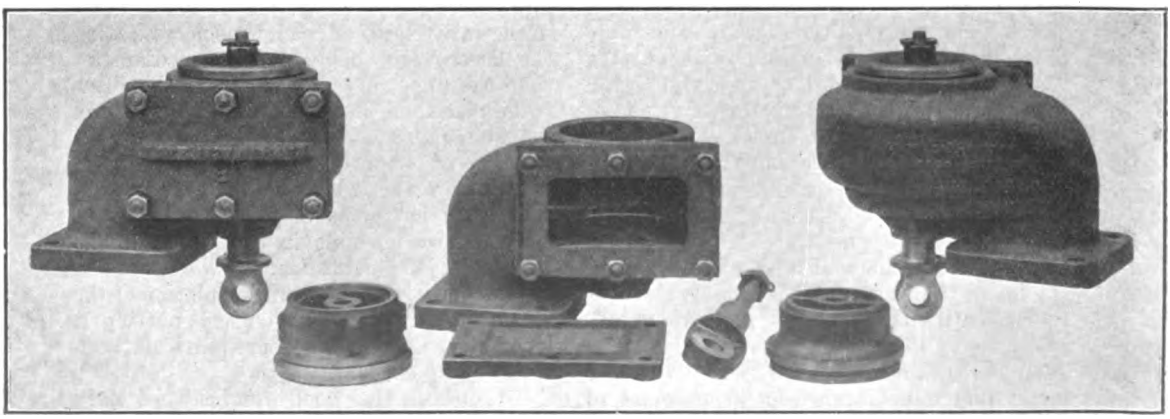
THE "LOCKYER" BALANCED DOUBLE-BEAT REGULATOR VALVE.

supply, it is necessary to have the two valve faces of equal effective diameter and to baffle the steam when passing them as the valve is being opened. The "Lockyer" regulator valve, supplied by the A.B.C. Coupler Co., Ltd., is claimed to attain these results in a simple and effective manner, as will be seen from the appended illustrations.

The valve is in two parts, A and B, the upper and lower portions of which have their respective valve faces, D and E, of equal effective diameter. This being the case the lower valve portion, B, cannot be passed through the upper valve seat, and provision is made to put it on to its seat through an opening, F, in the side of the head or chest. The upper valve portion, A, is then placed in position in the usual way and both portions bolted together on the spindle, C, which actuates them. It will be seen from this that the lower valve face can be made larger in diameter than the upper one, if circumstances require such a combination.

The regulation and graduation of the steam supply is attained in the valve itself. Below the mitre of the lower valve face there is a plain cylindrical part or baffle, H, of a given depth which prevents any rush of steam passing this valve as it opens. Below the mitre of the upper valve face there is provided a plain conical part or baffle, K, so that when the valve begins to move the annular space between the conical baffle and the valve seat gradually increases, and when the valve lifts the distance equal to the depth of the baffles, both upper and lower valves allow of the free passage of the steam until the maximum opening is reached.

"Ross" muffled safety valves are also fitted to many of the modern locomotives.



DETAILS OF "LOCKYER" BALANCED DOUBLE-BEAT REGULATOR VALVE.

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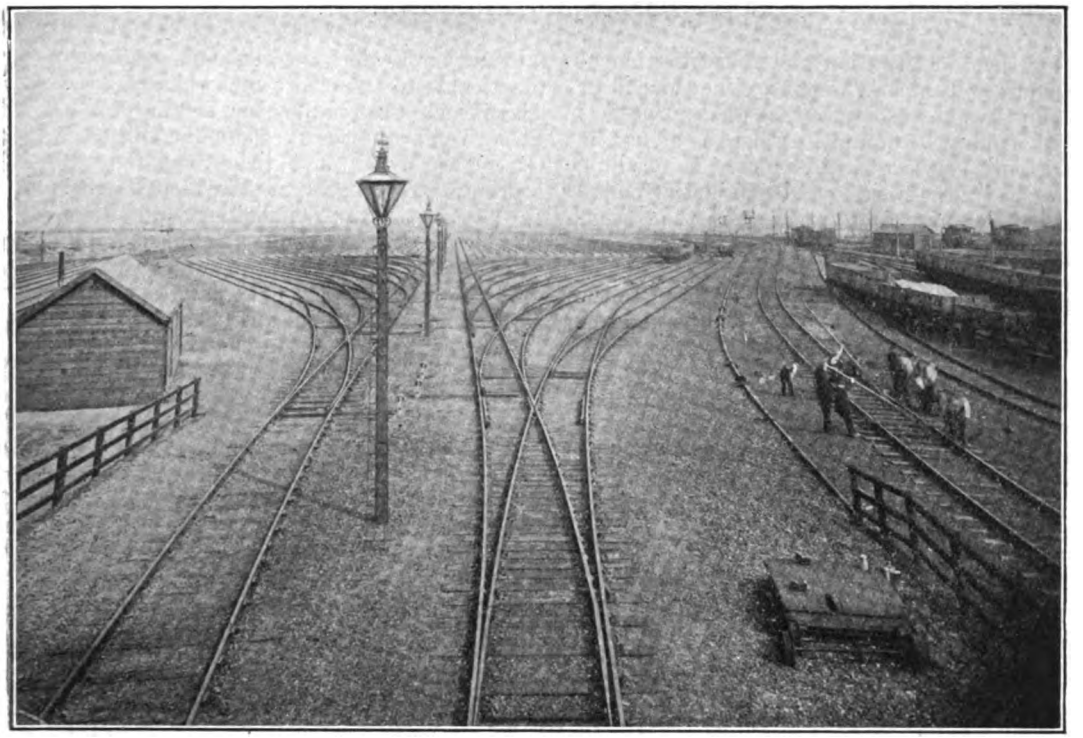

ERIMUS DOWN YARD, LOOKING EAST.

Freight Marshalling Yards.

By W. F. LAWRENCE.

NOT the least interesting phase of railway operations is that which is concerned with the working of goods and mineral traffic through the large marshalling yards which serve as collecting and distributing grounds for traffic passing from one part of the country to another.

The technical name by which yards or depôts of the description under notice are known varies. Some railway companies prefer to continue the old designation of "marshalling yard," others use the term "sorting sidings," whilst "concentration yard" is another departure from the general nomenclature. Probably the yards are best described as sorting sidings, seeing that the marshalling of wagons on trains in a proscribed order does not by any means embrace the full scope of their purpose; in fact, it is a frequent practice, within certain limits, for a train to leave a so-called marshalling yard rough, that is, with its load unsorted, while, on the other hand, trains regularly arrive at such yards in a fully marshalled condition. Where marshalling does take place it is as a rule a subsidiary operation following after the main classification of wagons into district order in the sorting sidings.

Direct forwarding in full train loads from point to point is obviously not always practicable; as goods in small consignments are staged from warehouse to warehouse for transhipment and combination, so wagon loads are hauled between the marshalling centres with the object of attaining the dual result of regularity and promptitude in despatch and delivery and economy in methods of transportation, and it is here proposed to review in non-technical language the governing principles associated with the functions, lay-out, and equipment of such yards, and to refer to some present-day methods of operation.

The primary purpose of a marshalling yard is that it shall serve as a convenient centre

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for the concentration and redistribution of goods and mineral wagons, either loaded or empty, and to so serve that dual purpose as to facilitate prompt exchange of traffic flowing in various directions. Marshalling yards are the starting and terminating points of the chief freight trains, from the "pick-ups" which serve all the stations on the branches radiating from the traffic centre at which the sorting sidings are situated, to the braked or express goods trains which carry the products of the industrial towns across the country in every direction or bring inland the raw materials imported through the railway ports. The provision of such yards is also a means towards ensuring a satisfactory supply of goods and mineral wagons for the traffic-creating zones and for holding in reserve stocks of traffic the delivery of which cannot be kept up to the mineral yards which are situated as near as practicable to the centre of a colliery area. Three such examples occur in the North Eastern mineral yards at Stella Gill and Gascoigne Wood, and the Great Central concentration sidings at Wath-on-Dearne. In the case of town marshalling yards there is generally an appreciable amount of traffic to and from the local goods warehouse and station yards which has to be passed through the sidings, and this means that the nearer the sorting sidings are to the goods station the more economically can the traffic locally produced or consumed be dealt with. Proximity of the marshalling yard spells a minimum of expense in haulage by pilot engines between yard and yard, allows of later despatch of outward traffic from the station yard and warehouses, and a more prompt arrival there of inward wagons. It is

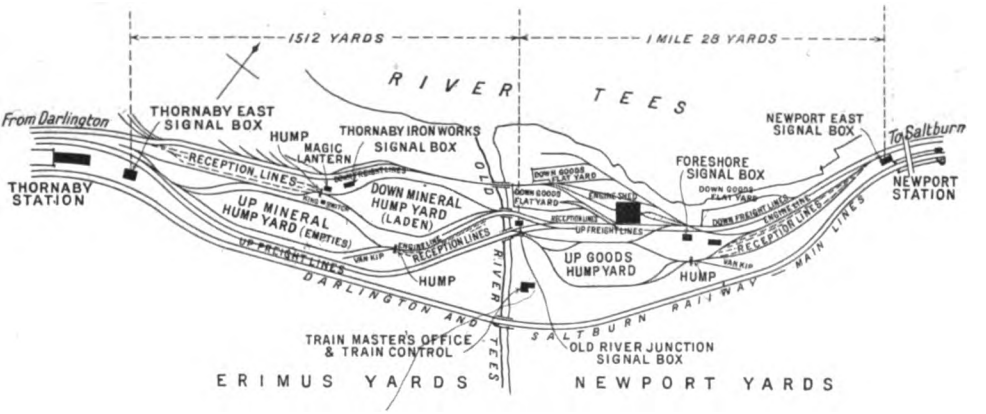

DIAGRAM OF ERIMUS AND NEWPORT YARDS, NORTH EASTERN RAILWAY.

rate of forwarding. This is not intended to imply that the railway companies recognise the holding of traffic in wagons pending delivery as a general practice, but on occasions that is necessary, and at the ports it is a daily occurrence for large numbers of wagons laden with coal for shipment to be stored in the sidings in order that there may be no detention to the boats by reason of a shortage of coal for bunkers or cargo.

In planning a marshalling yard there are several considerations which have to be taken into account, apart from the very obvious one of geographical location. It goes almost without saying that such yards are invariably found at important commercial centres, but there are also instances of sorting sidings being located some miles away from a town which can claim such a distinction. These, however, are chiefly usually necessary also to provide a marshalling yard at the junction where merchandise traffic is exchanged between two or more companies, particularly if there are several routes radiating from the exchange point. In such circumstances trains arriving from the connecting railways can be quickly sorted over so that the wagons are placed immediately into the sidings set apart for traffic for the respective routes, and in the opposite direction wagons reaching the marshalling yard from the various feeding lines can be promptly put together to form transfer trains for the receiving company.

Marshalling yards are provided for dealing with goods or mineral traffic exclusively and also for both classes of traffic together. Again, certain yards are reserved for specific descriptions of goods traffic, or for empty wagons solely. Some yards accommodate

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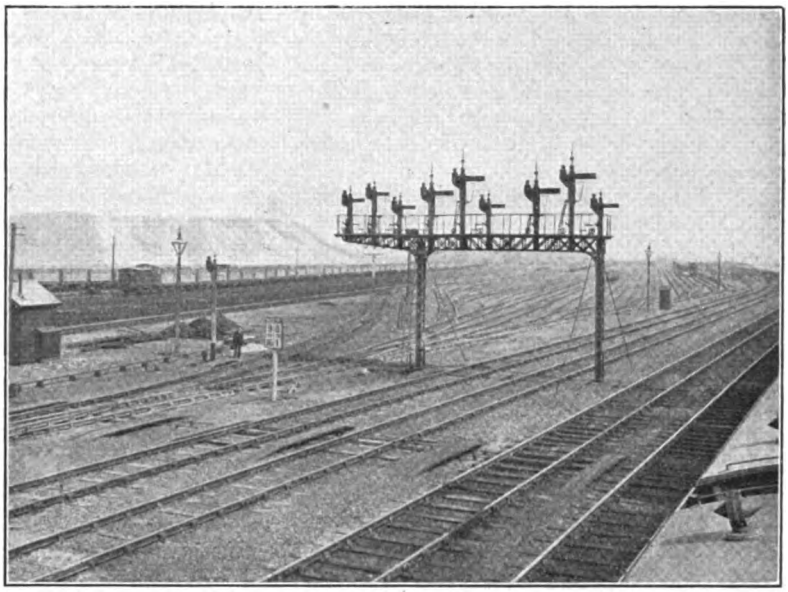
traffic intended for particular routes, and the purpose of others may be to sort together wagons containing goods for delivery at the station yards and warehouses, whilst on the other hand a separate yard is used for the distribution of wagons loaded out.



ERIMUS UP YARD, WEST END OF SIDINGS.

The first item in the equipment of a marshalling yard essentially consists of the sidings themselves, and these may vary from quite a few at a small yard up to from 20 to 30 or even more at a large sorting centre. The sidings may branch direct at short intervals from one long line of rails, or, as is more usual, be laid out in groups, each entered by a direct junction with the siding adjacent to the train running line.

The sidings are allocated for specific purposes, that is, for the accommodation of wagons for particular destinations, or for wagons requiring repairs, the storage of empty wagons, spare guards' vans, loads which require adjustment, etc., etc. As an example, the allocation of the sidings in a typical goods marshalling yard dealing with traffic to and from all directions might be as follows :—

Siding No.	*Allocation.*
1 to 4	South Main Line Stations.
5 to 8	South Branch Line Stations.
9 to 12	North Main Line Stations.
13 to 16	North Branch Line Stations.
17	Spare Guards' Vans.
18	West Branch Line Stations.
19	East Branch Line Stations.
20	Dirty Cattle Wagons to be cleansed.
21	Clean Cattle Wagons.
22	Empty Goods Wagons.
23	Railway Companies' Wagons for Repairs.
24	Wagons for Repairs by Private Wagon Contractors.

For the accommodation of trains which cannot be broken up immediately on arrival, reception lines, sometimes termed "independents," are provided, these varying in number and length according to local requirements. In some instances these reception lines are placed between the main running line and the groups of sidings, or between two sections of the yard, and in others they run tandem to the sorting sidings. As a general rule the former arrangement applies, the tandem reception line being more suitable for hump yards, respecting which some remarks are made later.

In many cases the reception sidings are not entered direct from the main passenger lines, but lead off a running independent or goods line which is controlled by the block telegraph method of signalling—often the permissive or recording system. By this means congestion, which may at any time arise in the marshalling yard and result in trains being held back in the reception sidings, is not so liable to react upon the main line working.

The entrance and exit to and from the sidings is controlled by points worked from a signal box at the junction with the main line, whilst in yards covering an extensive area which it is necessary to divide into sections there are frequently to be found one or more signal boxes controlling the movements within the marshalling yard itself and having no connection with the main line working. So far as the switches giving access to the various sidings within the yard are

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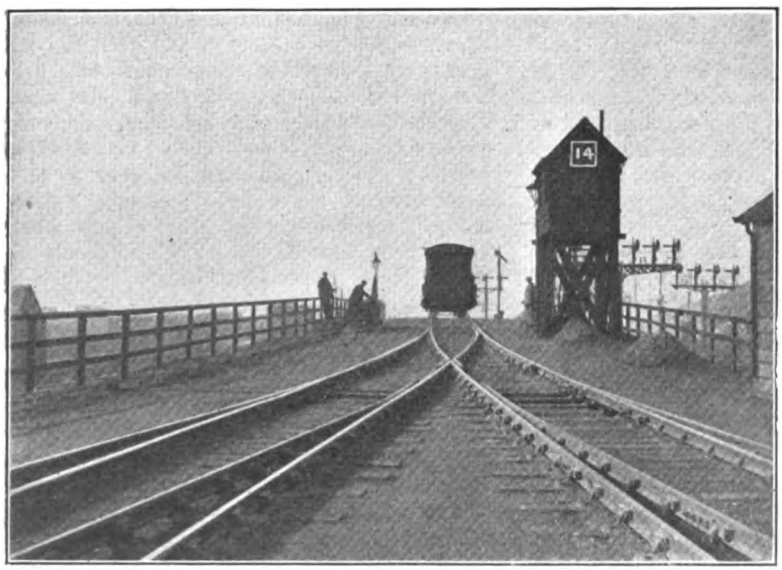
concerned, these are usually operated by hand and are arranged on the " hold-up " or the " throw-over " principle, the levers being placed as far as practicable in such a position that they lie normally parallel with the rails and thus minimise risk of accident to persons proceeding down the sidings.

All sidings do not terminate in a dead end, but. on the contrary, some yards are double-ended, wagons being run into the sidings at one end and led away from the opposite end, or shunted in from both directions. In shunting wagons into such sidings care has to be exercised that the wagons do not run right through, and, when practicable, assistance in that direction is rendered by the sidings being slightly dished, so that after passing a certain point the rising gradient tends to prevent overrunning. This remark applies more particularly to nominally flat yards, where it is not the practice to make use of the wagon brakes to any appreciable extent in shunting operations, although there are also hump yards which have the sorting sidings dished.

At some of the more up-to-date marshalling yards, and particularly where there are two or more reception lines, indicators are provided in the controlling signal box which show the state of the reception roads so that the signalman may know whether such are clear, or, if not, how many trains are standing in each awaiting their turn to enter the yard proper. Telephonic communication is also provided on local and district circuits giving direct speaking facilities between the various sections of the yard, the signal boxes, and also between the yards and the offices of the district traffic and locomotive department officials. In cases where a regular telephone attendant is not employed loud sounding gongs placed outside the telephone room take the place of the usual bells and thus the foremen, although engaged in the sidings, hear the call and can give attention without undue delay.

Other structural adjuncts to a marshalling yard comprise offices for yard masters and assistants and foremen, shunters' and guards' cabins, mess rooms and other miscellaneous erections; also, at exchange junctions, offices for the Railway Clearing House number-takers who record the transfer of every wagon which passes between one company's system and another. The offices of the train control staff, where that system is in operation, are located in the marshalling yard.

The type of locomotive in general favour for shunting work is the tank engine. The reasons for that are mainly of a character which appeal more particularly to students of locomotive matters and need not be expounded in an article of this nature, although it may not be out of place to indicate briefly the advantages possessed by tank engines from a traffic standpoint. The chief of these, not necessarily in order of importance, are a short wheelbase, enabling quick clearing of fouling points, a lower percentage of non-productive time on account of coaling, watering, etc., and generally greater despatch in the conduct of shunting operations consequent upon that type of engine being specially constructed to run with equal facility in both directions.



ERIMUS DOWN YARD SHOWING HUMP, LANTERN TOWER AND GROUND FRAME AT SUMMIT.

The tank engines themselves differ considerably in details of construction,

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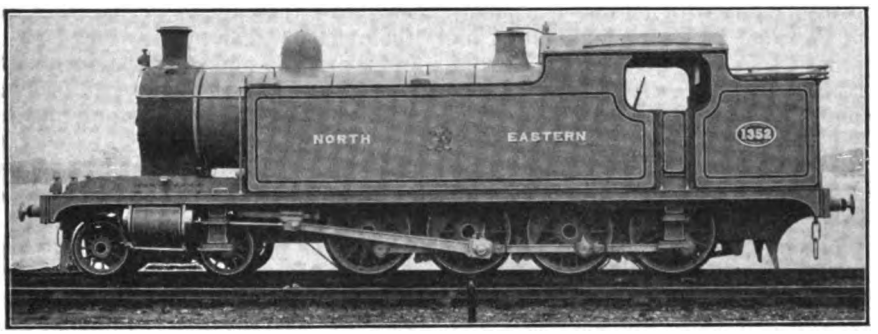
power, etc., from the small 0-6-0 saddle tank to the giant 4-8-0 three-cylinder side tank engines, such as the North Eastern class X type, designed for handling the heavy goods and mineral traffic passing through the hump yards on that line, and which weigh 84 tons 15 cwts. in working order, or the even larger Great Central hump engines with reverse wheel arrangement and weighing no less than 96 tons 11 cwts. in working order.

The following list may be taken as a guide to the diverse grades of men employed in the actual working of marshalling yards :—

District Traffic Foremen and Assistants.
General Foremen and Assistants.
Train Foremen and Assistants.
Foremen Shunters and Assistants.
Head Shunters.
Shunters.
Horse Shunters.
Chain Horse Lads.
Signalmen.
Pointsmen.

The general foreman is the man directly responsible to the yard master or station-master for the efficient working of the yard, although that man's duties comprise the supervision of the station yard and ware-house where a district traffic foreman is not employed, in which case greater responsibility rests with the train foremen who are actively engaged in connection with the arrival and departure of the trains and the shunting movements which are involved in the work of sectionising or marshalling. The foremen shunters or head shunters take charge of groups of sidings and are concerned with the proper allocation of the shunters or brakesmen with a view to keeping control of the wagons during shunting operations.

In addition to attending to the disposal of the wagons it is the duty of the marshalling yard staff to keep a sharp look-out for any wagons the loads of which may have come



4-8-0 THREE-CYLINDER TANK ENGINE, NORTH EASTERN RAILWAY, AS USED FOR "HUMP" SHUNTING

Wagon Couplers.
Switch Lads.
Lad Porters for recording weights of wagons.

In addition, the following grades, although not assisting in the actual working operations of the yards themselves, are engaged in duties associated with the yards :—

Clerks (in Yard Masters' Offices).
Goods and Mineral Guards and Assistant Guards.
Van Attendants (Cleaners).
Loads Inspectors.
Wagon Inspectors.
Number-takers.
Lampmen and Lads.
Cattle Wagon Cleaners.
Telegraphists.
Telephone Attendants.
Timekeepers.
Storekeepers.

The list is not exhaustive; on the other hand, the whole of the grades mentioned are not universally employed.

adrift during transit or which require adjustment, and it is for that purpose that at important yards through which a large number of awkward loads regularly pass load examiners are employed. The traffic particularly in mind consists chiefly of large ships' plates, long angle iron, propellers, girders, and productions of the iron and steel works generally, as well as round timber, pit props, etc.

Marshalling yards may be divided into three classes, namely :—

1. Flat Yards.
2. Gravitation Yards.
3. Hump Yards.

It is hardly necessary to say that the first-named is by far the most common type of yard, having been, in fact, until within quite recent years almost universal on British railways. In classifying wagons in such a yard the shunting engine takes from the

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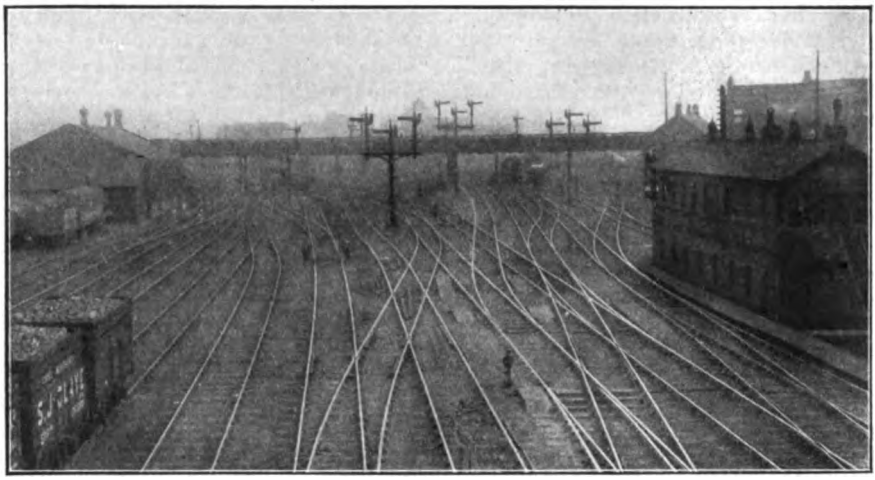

Photo] [*R. Baker.*

YORK (N.E.R.) MARSHALLING YARD, LOOKING EAST.

reception line as many wagons as can be conveniently dealt with at one time, and, working on what is known as a shunting neck, proceeds to sort the wagons into the respective sidings by a series of shuttle movements. It will be seen that practically each shunt means a forward and then a backward movement, except in cases where a cut or detachment of wagons is allowed to run into the siding and the wagons next in the rear are brought to rest before they reach the fouling point of the siding being fed and that into which the following cut of wagons is to be shunted. In actual practice the extent to which the shuttle movement is repeated depends in a large measure upon the skill of the shunters; good shunting, so far as this particular phase of the operation is concerned, is indicated by keeping down to the minimum the number of times the engine draws back between the shunts. The complete operation is gone through with each separate cut of wagons, a shunter uncoupling another wagon, or batch thereof as the case may be, immediately after the engine has drawn the wagons attached thereto back so as to clear the points which will control the next shunt.

In flat shunting it is frequently unnecessary to use the wagon brakes, as in running on the level the wagons lose momentum sufficiently early after leaving the engine to prevent violent collision with those already standing in the sidings, and it is practicable to control the speed at which the engine gives them a start in proportion to the distance the wagons are required to run. In flat shunting one man (termed the "stickman") uncouples the wagons and controls the movements of the engine, whilst other shunters (pointsmen) manipulate the loose levers actuating the points at the entrance to the various sidings, the number of such pointsmen depending upon the requirements of the occasion.

Gradient yards have a slight fall through the reception lines to the end of the sidings, so that when the wagons on an arriving train have to be sorted into the sidings, all that is necessary is to release the brakes and allow the trucks to gravitate from the reception line to the required siding without the employment of locomotive power. With this system an uncoupler is, of course, engaged on the reception line, and there are also switchmen and brakesmen controlling the movements down the gradient. At some yards each brakesman releases his own cut and travels with it into the siding, afterwards returning to the reception line for another batch.

Gradient shunting is quicker than flat shunting, and the saving in locomotive power and wear and tear to wagon stock is a strong recommendation, but there are disadvantages in other directions, *e.g.*, the whole train must be standing on a falling gradient before shunting is commenced, and it is necessary that each wagon or cut be accompanied and controlled from the commencement of its journey, otherwise the wagons first released would have least way on them and be liable to stop short in the sidings, whilst the wagons at the rear of the train gained the maximum of momentum, and these two factors acting contrary the one to

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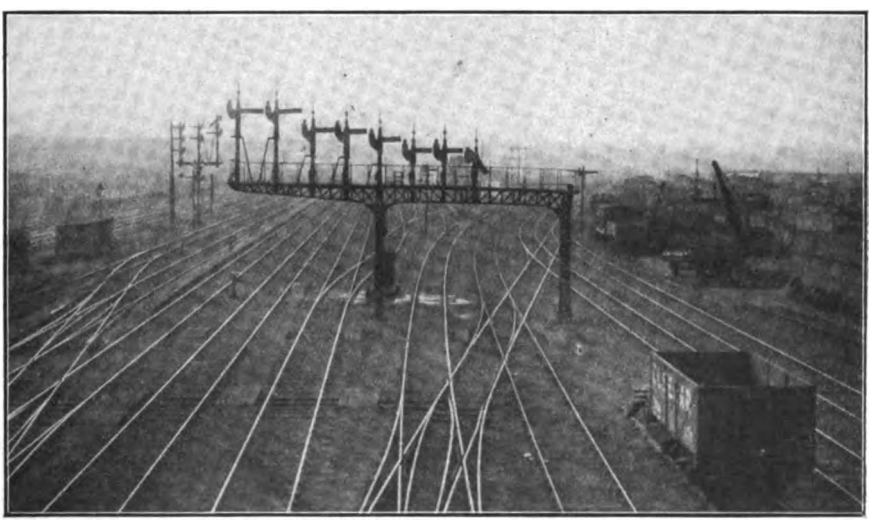
the other, would combine to produce liability to heavy impacts with consequent damage to both rolling stock and contents. The best example of gravitation shunting in this country is found in the London and North Western Company's Edge Hill yard at Liverpool, where the reception sidings will accommodate nearly 300 wagons, the sorting sidings 1,100, and about 2,500 wagons are dealt with daily.

A development and improvement on the gradient principle is seen in the hump shunting yard. These are generally considered to be an American introduction, although 30 years ago Mr. E. B. Ivatts, in his book on "Railway Management," recommended the gradient principle. Their installation in this country, however, followed after a visit of certain British railway officers to the States, and their merits and demerits have probably caused more controversy between experts in the handling of freight traffic than any other question coming within the scope of railway operating. Considerations of space preclude a lengthy survey of the arguments for and against the hump yards, though a few comparisons with flat shunting methods and results may properly be made. First, however, let it be said that not many of the British railway companies have yet had the temerity to depart from the old-fashioned system of shunting on the level—notable exceptions are the go-ahead Great Central, the London and North Western and the North Eastern, which by reason of its comparative freedom from competitors is regarded in some quarters as more prone than other companies to depart from the conventional in its traffic operations. The first-mentioned Company has a huge concentration yard laid out at Wath for dealing with the large flow of mineral traffic from the colliery districts in its area to the east coast ports; hump shunting is in operation at several places on the London and North Western system; and the North Eastern has no less than nine humps in everyday use: One at York (goods); two at Hull (goods); two at Gascoigne Wood (mineral); three at Middlesbrough (one goods, two mineral); and one at Stockton (goods).

The plan of a hump shunting yard is generally somewhat as follows. From the reception lines is laid a shunting neck which leads over the summit of the hump to the sorting sidings. At a short distance from the crown of the hump in the direction of the sidings the line bifurcates, leading to two groups of sidings which are entered through switches at suitable intervals. Where practicable the entrance to each siding is direct from the two centre lines just referred to, the space between these, which is termed the "switch street," being thus kept clear for the safe and expeditious passage of the pointsmen and brakesmen. With such an arrangement the necessity for the pointsmen to cross the sidings does not arise and the crossing by the brakesmen when attending the wagons is reduced to a minimum. The switch near the crown of the hump giving



Photo] [*R. Baker.*

YORK (N.E.R.) MARSHALLING YARD, LOOKING WEST.

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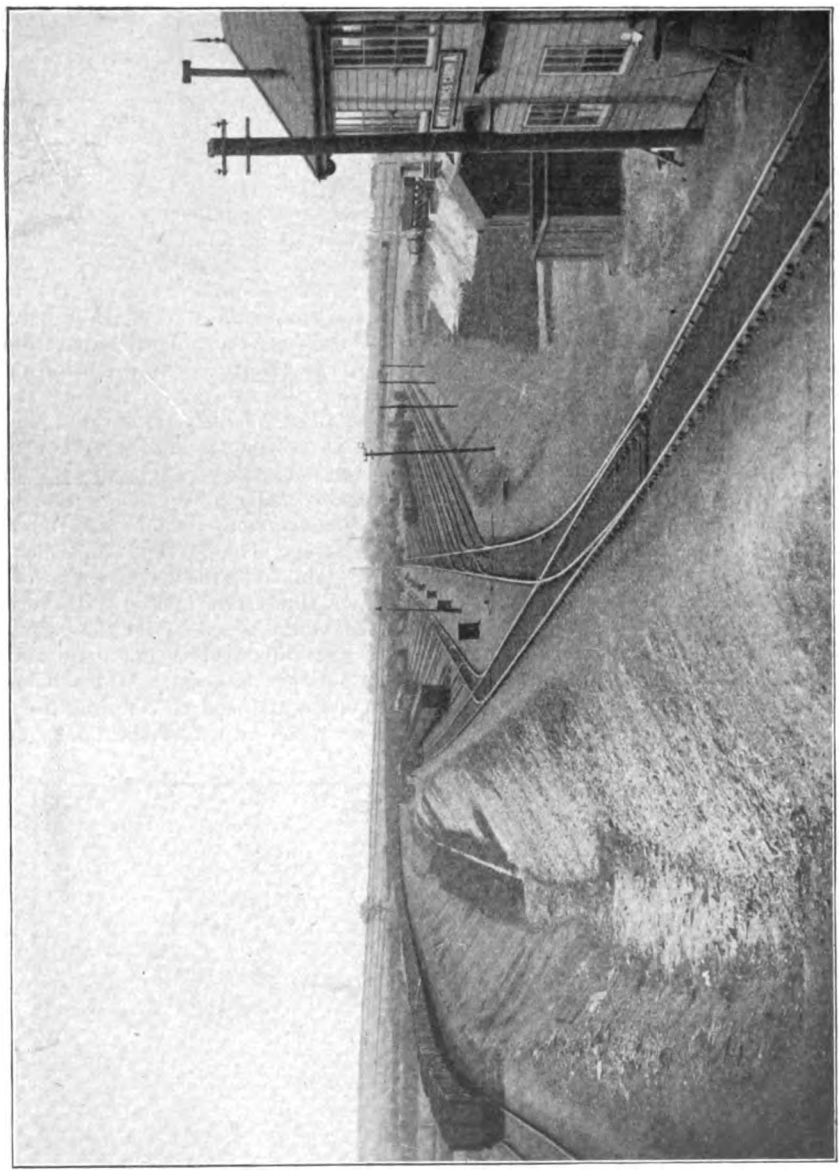
access to the two groups of sidings is known as the "king switch." The gradient from the summit of the hump to the sorting sidings varies from approximately 1 in 30 to 1 in 130 and through the sidings from the level to a slight rise near the terminal end.

batch of wagons the number of the siding into which such batch is to be shunted. This duty completed and, in the case of night working, the pointsmen and brakesmen having been advised as to the order in which the cuts will leave the hump, the load is



SHUNTING SIDINGS AT WATH, GREAT CENTRAL RAILWAY.
Controlled by British Pneumatic Signal Co.'s Electro-pneumatic Signalling.

In shunting a train of wagons over a hump the *modus operandi* is as follows: Whilst the wagons are standing in the reception siding a shunter, technically termed a "chalker," examines the tickets of each truck and chalks on what will become the leading end of each

taken to the shunting neck and from there propelled over the hump by the hump engine at such a speed as will give the pointsmen and brakesmen an opportunity of meeting each cut as it descends on the other side and seeing that it is safely landed at the required

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position in its predestined siding. Where the reception line runs tandem to the yard the train in the order in which it arrives is, of course, simply pushed over the hump. On some humps, in mineral yards generally, it is the practice for the brakesman to ride on one of the wagons in each cut from the crown of the hump until they reach their destination in the siding or until the wagons are so far under control as to render it safe for them to be allowed to continue the journey unattended.

The speed of propelling of course varies with the grade of the hump, the weather conditions, the number of wagons in the cuts, etc., but an average rate is from one to 1½ miles per hour. When it is remembered that a train of upwards of 60 wagons is frequently propelled over the humps in one operation, and that such a low rate of speed has to be maintained, it will be readily recognised how necessary it is to employ for the purpose engines having a great adhesive power. In the case of the Great Central hump engines already referred to the adhesion weight is 73 tons 12 cwts., and that of the North Eastern is 66 tons 17 cwts.

There are slight variations in the method of indicating the destination of the several cuts of wagons. For instance, on some American humps the siding number is shown on the last vehicle of the preceding cut, whilst in some of the British yards a mechanical indicator is fixed at the summit which gives visual announcements and which is illuminated at night.

It has been said that the introduction of hump shunting has met with considerable opposition, and that, coming as it has done from experts, cannot be lightly brushed aside or ascribed to prejudice against American innovations. Whilst leaving the reader to form his own conclusions on the matter, the subjoined remarks, which are based upon practical experience and observation of both hump and flat shunting and an impartial consideration of the question, may serve as a moderate statement of the case.

The primary object of hump shunting is to increase the capacity of the marshalling yard by the expedient of a more rapid turnover of the wagons. Where an old flat yard has been remodelled and a hump installed, that has been the object in view, and it may also be taken for granted that, from the standpoint of the hump partisan, in the case of a new yard the capacity for handling traffic expeditiously is greater by reason of its being adapted as a hump yard than would have been the case had it been laid out on the flat. There stands a direct claim that hump shunting is faster than flat shunting. Experience shows that the average number of wagons which can be shunted per hour in a flat yard is about 60, whilst over 100 wagons per hour can be shunted over a hump, and in certain yards 200 wagons per hour has been exceeded. In each case goods marshalling yards are referred to, but it may be taken that the results in regard to mineral yards are in practically the same ratio.

The advocates of flat shunting hold the view that damage to wagons, and, as a consequence, to goods is an inevitable complement to hump shunting. The contention is that, by allowing wagons to run off a hill and entrusting the reduction in speed which must be effected within a comparatively short distance to the ability of a man to apply the brakes at the psychological moment, mishaps are practically invited. That there is greater risk of wagons coming into violent contact in hump shunting is very doubtful; wagons are occasionally subject to rough treatment even in flat shunting, and damages occur, but of a different character, *e.g.*, drawbars are pulled out and coupling links give way consequent upon sudden starts and stoppages and the alternation of heavy and lighter wagons during the backward and forward movement already referred to. In the case of wagons running off a hump the damages which may occur are more likely to take the form of cracked axle boxes or fractured buffing gear, and it is at least probable that the wear and tear on rolling stock is less in hump than in flat yards. As to the damage to goods, it is the generally accepted opinion that it is practically impossible to so pack general merchandise in wagons that the load remains rigid during shunting operations and it would seem that the recurring backward and forward movement entailed in flat shunting would keep the load constantly on the move and have a more harmful effect than an occasional bodily shifting which might follow after somewhat severe checks sustained by a wagon during its progress through a hump yard.

In consequence of hump shunting being conducted much more quickly than on the flat, greater judgment and smartness is required in the handling of the wagons, and a sufficient supply of capable brakesmen is essential if the full advantage of the system is to be obtained. A hump gives expedition,

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but if it is attempted to work it on cheap lines the saving accruing from quicker working will disappear in the cost of repairs to and shunting out of damaged trucks, and the time lost by rectifying wrong shunts, that is, cases where wagons have been turned into the wrong siding, either by error on the part of the pointsman or by the staff being insufficient to properly deal with the cuts as they descend the hump. Good judgment on the part of the men is also required in deciding to what extent to retard the progress of wagons of varying types and with differing running properties, *e.g.*, wagons with oil lubrication run more freely than those having "fat" axle boxes, so that in hump shunting the human element, as in all other operations relating to the conduct of the railways, is a telling factor.

The cost of operation naturally enters into the question of hump *versus* flat shunting, and, so far as the writer has been able to obtain information, such goes to show that the advantage is with the humps, and in connection with the question of cost as applied to both operation and repairs, it is interesting to note the opinion recently expressed by an American Yard Máster that "the most economical method of breaking up and classifying trains is secured in the hump yard, which not only reduces the yard switching movements and the operation cost to the minimum, but materially decreases the switching causes of damage to equipment," and that "one Mallet locomotive with 30 car riders will weigh and classify more cars in an 11-hours' working day in a gravity yard than 10 switch engines and crews working in flat yards, and with fully one-half less damage to equipment."

Whilst touching upon the matter of speed in working it may be remarked that quick turnover of wagon stock is a factor of prime importance in railway operating. Goods and mineral trucks are expensive items of equipment, and it is intended that they shall be kept moving as expeditiously as possible so that a profitable number of loaded journeys may be obtained within a given time, therefore from the point of view of economical wagon user there is necessity for the quickest practicable means of working to be applied to marshalling yards. Such yards should not be places of detention to rolling stock, but rather the reverse.

Apart altogether from the railway companies' efforts to get the best use out of the wagon stock, however, quick working in the yards is increasingly demanded as a means of ensuring punctuality in train services and prompt deliveries of traffic, and in the solving of the problem of quick despatch whilst avoiding damage to traffic and equipment lies a factor which taxes to the full extent the ingenuity of those responsible for the efficient fulfilment of the functions of marshalling yards. Two apparently opposite demands must be satisfied, and means must be devised whereby rapid handling is combined with freedom from damage. When it is remembered that it is generally during the dark hours that the bulk of the work is carried on, the difficulties may the better be appreciated. This latter circumstance may at times involve a temptation to sacrifice care to the attainment of speed, but in spite of the somewhat frequent suggestion from traders and others who are not in a position to judge that rough shunting is common, the writer, speaking from intimate knowledge of the facts, does not hesitate to assert that carelessness in that direction is by no means a regular practice, either in hump or flat yards, but that, on the contrary, greater care is exercised to-day in shunting operations than was ever the case formerly. An allegation of rough shunting is not infrequently based upon the circumstantial evidence of a loud noise, but that is decidedly dangerous ground upon which to found such a charge. Noise is not necessarily to be associated with rough handling of wagons; on the other hand, it is not at all incompatible with reasonable shunting. Much depends upon the local surroundings, the types of wagons, power of resistance in buffer springs, whether the wagons are loaded or empty, and various other factors.

The system of lubrication of axle boxes on railway wagons in this country is in a state of transition from grease to oil, and it is not difficult to appreciate that that has a material effect upon shunting work. Probably no two consecutive wagons have the same running property, and the indiscriminate and unavoidable combination of oil and grease lubricated wagons in one cut militates against all efforts to judge accurately as to how the wagons should be handled. The differing degrees of retarding capacity and promptitude in action of wagon brakes is also a factor to be reckoned with, particularly in hump shunting.

In the majority of yards such disadvantages as those instanced have to be met by judicious distribution of the brakesmen, their positions being varied with changing circumstances, but two mechanical

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appliances which have been devised to assist shunters in preventing accident in the event of a wagon unexpectedly gaining momentum may be described. The first is the chain drag which is employed in the London and North Western Edge Hill gravitation yard and consists of hooks placed horizontally in the four-foot at suitable intervals. The hooks are attached to heavy chains, which in their turn are secured to a drum in an underground tank. By the manipulation of a lever on the part of a pointsman or brakesman the hook is made to assume the upright position whenever a wagon is seen to be approaching at such an excessive speed as to threaten disaster. The hook then engages with the leading axle of the wagon as it passes with the result that the vehicle has to carry the additional weight of the chain—about 5 tons —and is thus gradually brought under control. It speaks well for the staff at Edge Hill that the chain drags are very seldom called into service.

The other appliance is what is known as a hump slipper. This is something similar to the brake shoe used for road vehicles, but the flange is made in the reverse direction so that instead of coming into contact with the wheel tyre it fits on either side of the rail, and it is provided with a strong stop to hold the wagon wheel. This shoe, the bottom of which is well greased, is placed on the rail at a suitable distance in advance of an approaching vehicle and one of the leading wheels of the wagon is caught by the slipper, which is thus pushed along the rail and the rotary action of the wheel is diminished until it ceases altogether. At a fixed point in the siding or braking road is a switch so constructed as to free the slipper from the wheel without the liability of derailment of the wagon.

Experiments have been made from time to time with an appliance intended to check the speed of wagons, which takes the form of a track brake. This consists of two movable check rails placed opposite each other and operated by an upright lever fixed in a ground frame. The two check rails are held in position by either spiral or laminated springs placed between them at intervals, and the manipulation of the lever causes the track brake to expand and contract, thus varying the distance between the check and stock rails in accordance with requirements. The track brake is somewhat higher than the rail and thereby obtains a firmer hold of the wheel flanges when fully applied.

Whilst expeditious working is to be sought after, the cost of operating marshalling yards is carefully watched by the responsible officials, and for this purpose records are kept showing the number of trains entering and leaving the yards, the number of wagons detached by incoming trains, the time occupied by train engines and pilot engines respectively in shunting, and the wages paid to the operating staff. the form and details of the records of course varying with different companies. It is, however, by no means an easy matter to arrive at a figure which will indicate satisfactorily the actual cost of working. The unit adopted by one company is the yard wages per wagon detached, but whilst the returns are always compiled on the same basis and therefore provide a means of comparison of results during corresponding periods, it is not practicable to show what is the actual cost of handling the wagons. For instance, one wagon may be shunted only once in a particular yard, whereas another may be shunted several times in different sections of the yard, or at one yard it may be necessary to turn over several times a large percentage of the wagons which pass through, whilst at another yard such multiple handling is the exception, yet in all these cases each wagon would be counted once only. Again, in the hump yards the cost of wages paid to operating staff may be greater than in the flat yards, but the locomotive cost on the other hand much less, and in that case the records might indicate a higher cost of working the hump yards, although the reverse is probably more correct.

It is, however, manifestly impracticable to record each movement of individual wagons or to debit each yard in one complete account with its due proportion of cost in enginemen's time, coal and water consumption, wages of operating men, and all the minor items of expense associated with the yard. Sufficient has been said to show the importance of economical as well as expeditious manipulation of the traffic passing through the yards, of whatever type it may be, and the best results are undoubtedly obtained by close and constant attention to the details of working on the part of the yard masters and their assistants rather than by studying periodical returns.

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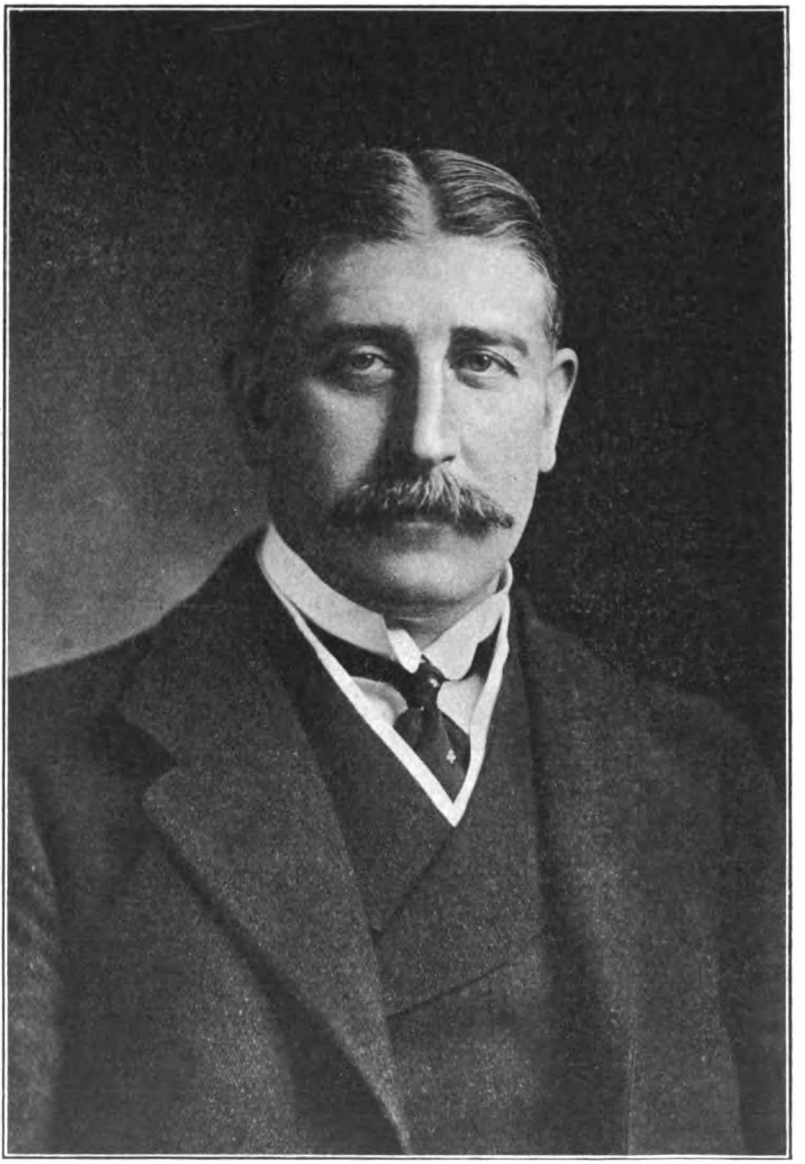
THE RAILWAY PORTRAIT GALLERY.



Photo] [*Elliott & Fry.*

SIR HERBERT ASHCOMBE WALKER.

General Manager, London and South Western Railway.
Chairman, Railway Executive Committee.

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SIR HERBERT ASHCOMBE WALKER,

:: General Manager, ::

London and South Western Railway.

FROM the railway point of view the most interesting of the New Year's Honours is the knighthood conferred on Mr. H. A. Walker, General Manager, London and South Western Railway, and Chairman of the Railway Executive Committee. With Southampton as the point of embarkation for the Expeditionary Forces, an exceptionally heavy strain was placed on the London and South Western Railway Company, which has done so much to bring that port to its present high standard of equipment, whilst the duties of Chairman of the Railway Executive Committee have called for administrative qualities and tact of the highest order.

A new portrait of Sir Herbert Walker is reproduced on the opposite page.

Sir Herbert Ashcombe Walker was born in London in 1868. The son of a medical practitioner, he was trained with a view to the same profession. His education began at the North London Collegiate School, was continued abroad, and completed by private tuition. He then passed the Apothecaries' Hall examination, but, for family reasons, abandoned medical studies, and entered the railway world. This was in April, 1885, as a clerk in the office of the District Superintendent of the London and North Western Railway at Euston, under Sir Robert Turnbull. There he remained for two and a half years, until transferred to the office of the Superintendent of the Line, over which Mr. G. P. Neele presided. In January, 1889, Mr. Walker was appointed outdoor assistant to the Superintendent of the Line. After four years' experience in this capacity he became Assistant District Superintendent in the North Wales Division, with headquarters at Chester. Ten months later he was appointed Assistant District Superintendent of the Southern Division between London and Stafford. Nine years later he became District Superintendent, and soon afterwards was directed to visit the United States, with a view to ascertain how far and in what, if any, respect, American traffic methods could be advantageously introduced in British railway practice. As the outcome of his investigation, Mr. Walker prepared a series of extremely valuable reports on important subjects. In October, 1909, Mr. Walker received the appointment of Assistant to the Superintendent of the Line, and in July, 1910, became Outdoor Goods Manager for the southern half of the London and North Western system. Mr. Walker was closely concerned in the working absorption by the London and North Western of the North London Railway in December, 1908, and it fell to his lot to reorganise the whole of the arrangements of the latter. He had also much to do with the Conciliation scheme of 1907, and was generally so well informed concerning the working of the scheme on the London and North Western system, that he came to be regarded as its chief spokesman when important matters have called for outside inquiry. In January, 1912, he succeeded Sir Charles Owens as General Manager of the London and South Western Railway.

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Railway Electrical Progress and Practice.

By "INDICATOR."

IN the last two articles what may be termed operative or traffic working aspects of electrical railway practice have been considered. It is now proposed to deal more with certain directions in which electrical agencies are utilised incidentally, or as adjuncts to the actual traffic working equipment.

Speaking generally, one may suggest that electricity is so widely employed in railway service that it is almost superfluous to specify individual applications, such as telephones, telegraphs, indicators; power for cranes, lifts and capstans; for running shop machinery; for lighting; and for a wide variety of other uses. The subject matter is, indeed, of an exceptionally comprehensive character; at the same time a superfluity of generalisation is not conducive to real information, and so, on this occasion, it is proposed to deal more particularly with telephonic and telegraphic equipment, and with indicators and like devices which are of great incidental value.

It has been stated that the development of the electric telegraph has been contemporaneous with that of railways. This is not quite correct, but it is very nearly so, and it is remarkable that so many of the early telegraphic installations were operated along the railways, even public use being largely controlled by the railway staff, while even to-day a considerable proportion of public telegraphy is dealt with either in railway telegraph offices or over wires passing along the railway routes.

At an early period the electric telegraph was appreciated as a valuable adjunct to railway operation, as by no other means could the "policemen" or signalmen be informed of the movements of trains beyond their sphere of observation. It is usually stated that the first railway on which traffic was controlled by telegraphic advices was the Norwich and Yarmouth line, while interesting stories are told of the initial equipment between Paddington and Slough.

Reduced to its essentials block signalling is merely the application of simple telegraphy to traffic control. Actual messages are not usually exchanged, but the bell codes constitute an equivalent, while in the block instruments themselves the movements of the magnetically influenced needles directly correspond to those of needle telegraphic instruments. It may be that the needles are held in their indicating positions and the required indications are given thereby, whereas in message telegraphy specified oscillations "spell out" the desired words. But, just as in cable telegraphy code words are used by convention in place of long communications in ordinary language, so in the bell codes and in the indications of the block instruments similar principles are evidenced, elaborated more or less by track control—as in lock and block signalling—to meet the requirements of the particular situation.

Prior to the complete installation of fixed signals and their direct association with the telegraphic instruments, traffic was, where telegraphic equipment was provided, operated substantially on the train despatching system. The embrio form of this system quickly gave place to methods which led up to the standard system of block signalling, whereas, in America, the train despatching system was developed on its telegraphic basis. Later this system of working has to some extent been replaced or assisted by telephony, but there is one factor which renders telegraphy preferable to its rival and which suggests that it will always hold its own in some degree, if not in the majority of instances.

With the telegraph it is generally required that communications sent and received shall be written down, and in actual practice there is always a record of vital messages passing, so that while transmission is telegraphic, action is taken on the basis of communications which are, or always should be, available for reference and record, both at the time and afterwards.

Thus, in block signalling, the signalman is generally required to record the times he sends and receives code messages, while in other cases, although standard messages may pass unrecorded by virtue of their normal character, the fact that each is satisfied by

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TRAIN CONTROL SELECTOR KEY CASE FOR 21 STATIONS.
As supplied by the Western Electric Co., Ltd.

the completion of the operations which it directs, as also because of adjuncts and safeguards associated with the instruments and equipment, is usually sufficient. And in the train despatching system a complete record of all telegraphic communications is essential to the effective working of a section.

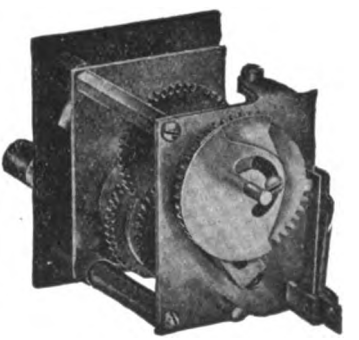
With the telephone, however, while the vital points may require to be recorded, as they should be, it is easy for more to be said than is essential. The fact that communication is to all intents and purposes verbal, may therefore, while of advantage in that the bald essentials of a telegraphic communication can be elaborated if required to give more complete information, conduce to elaboration without full record, even to the extent of introducing confusing elements.

For the control of actual train movements, apart from other factors, this appears to be, to some extent, a disadvantage, qualified by its value in specific instances, though several American railways claim to have satisfactorily displaced telegraphic by telephonic train despatching. In such cases there are rigid regulations, extending even, in many instances, to the specifying of standard phraseology, and this largely reduces what disadvantage, if any, there may be, and brings telephonic despatching virtually into line with the telegraphic system.

Where, however, the question is one of traffic control, as in the train control system, the problem is an essentially different one. It becomes then, in fact, one of the transmission of instructions as to what is to be done with various trains, co-ordinated by the special knowledge of a complete situation possessed by the "controller," while the signalling of train movements is carried on as usual. In that respect train control differs essentially from train despatching or train signalling, and the former may be likened to headquarters instructions, given on the basis of centralised information, while the men on the spot still have full control with their normal equipment of the actual train movements.

But while train signalling is still largely telegraphic it can be materially assisted by the telephone, for information purposes, and in many cases the latter is essential. And with the development of train control we have seen some of the most remarkable telephonic installations to be found anywhere. A public telephone exchange is a wonderful place, but after all it is little more than a combination of relatively simple elements multiplied to give wide scope of intercommunication; whereas a train control switchboard is designed to give telephonic communication to many places, in combination with indicators and adjuncts, and often including features whereby wires can be utilised for a number of purposes. It is, in fact, a telephonic exchange of a special character designed to suit particular conditions and requirements.

That a train control equipment is expensive is not denied, though after initial installation maintenance is usually light; and it is partly for that reason, in combination with absence of necessity where traffic is devoid of special characteristics, that train control is not universally applied. Where, however, conditions justify its inauguration train control telephonic equipment becomes more or less incidental as a means of achieving results correspondent to which the cost of the apparatus is a relatively minor matter. Already the Great Western, Great Central, Great Northern, Midland, London and North Western, Lancashire and Yorkshire, North



DETAILS OF SELECTOR SENDING KEY (BACK VIEW).

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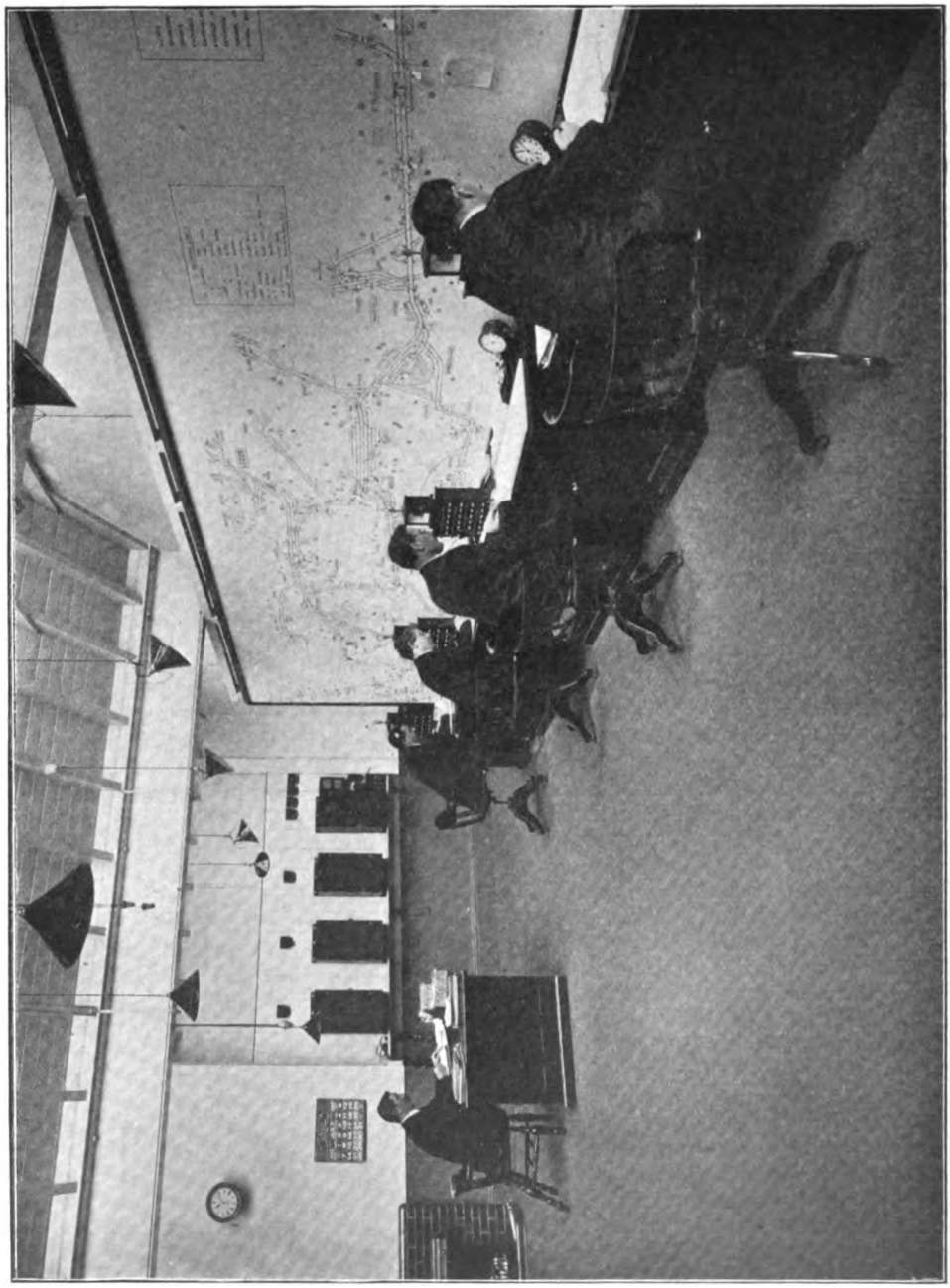

TRAIN CONTROL OFFICE: GREAT NORTHERN RAILWAY.
Equipped by the Western Electric Co., Ltd.

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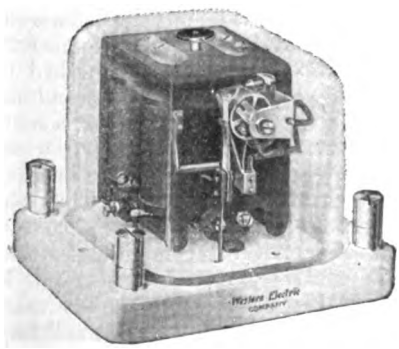
Eastern, Rhymney, Taff Vale, North British and several other railways have introduced control areas, and are extending these, while more than one other railway is taking steps in the same direction. In addition, apparatus of the same class is being introduced for inter-communication and other purposes.

As setting forth the advantages of train control the following comprehensive summary may be quoted :—

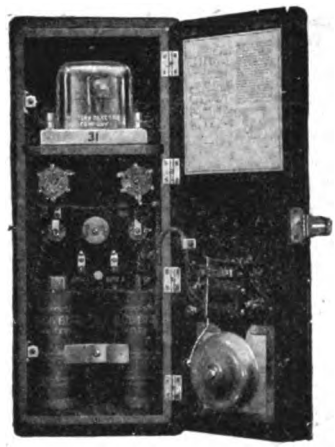
(1) No skilled telegraph operators required.
(2) Code ringing and Morse code messages abolished.
(3) Greatly facilitated regulation of traffic.
(4) 50 per cent. saving in time or operating efficiency obtainable.
(5) Solution of the empty goods truck problem.
(6) Lost journeys and lost time obviated.
(7) Fewer locomotives under steam.
(8) In case of accident or breakdown, delay to traffic and destruction of property minimised.
(9) Prevention of disorganization during strikes.
(10) Staff directly in touch with local headquarters.

These may be accepted as representing the main facts, though it has to be remembered that conditions require to be suitable before the heavy initial outlay entailed can be justified, and while the claims made in favour of train control are fully warranted in, say, 99 cases out of 100, there are possibilities that it will not be so satisfactory in other instances. On the whole, however, train control has proved its value, and it is hardly an exaggeration to suggest that over 50,000 miles of railway are now operated in this manner, and many additions are in progress. In America similar apparatus, either for control or for train despatching, is now very widely employed.

The following particulars of a specimen telephone installation for train control purposes, as equipped by the Western Electric Co., Ltd., will be of interest.



GENERAL VIEW OF SELECTOR.



SELECTOR SET (LOCAL BATTERY) IN CASE.

One of the above Sets at each Station, with a Telephone Set, completes the Way Station Equipment.

Until recently, messages by telephone were either transmitted from point to point, or several instruments were connected in bridge to one pair of wires, and the particular station required called by code signal. The principal disadvantages were the very limited number of stations which could be bridged across the one pair of lines, the long time taken to call the more distant stations by code ringing and the uncertainty of such means of calling, owing to mistakes made by the operator in manipulating the generator handle, or by the called station in counting the calls, or by the failure of the bell to respond properly to the rings sent out.

According to the Western Electric Company's system the time required to call stations is reduced fully 50 per cent., leaving the line more free for conversation, and reducing the delay in getting into communication. The operator has not to memorise a series of codes, but simply turns a key clearly labelled with the name of the station required. Only the bell at the station wanted is operated, and the attendant knows that he must answer promptly every time the bell rings. The operator at the calling station can hear when the bell rings at the distant station. When general instructions are to be given, all stations may be called simultaneously within a few seconds, and the arrangement of the telephone circuits are such that with twenty stations on the line simultaneously, the transmission is perfect.

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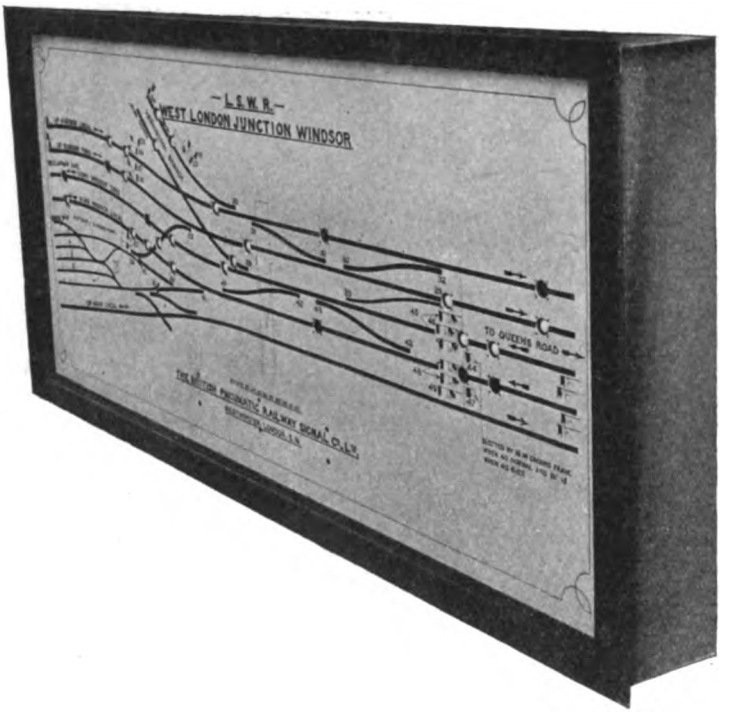

TRAIN LOCATION DIAGRAM.

British Pneumatic Railway Signal Co., Ltd.

The system more generally employed in connection with train control is to divide the whole of the line into convenient sections, each of which is put in charge of a controller, who is responsible for the traffic over that section of the line. The size of a section is determined principally by the volume of traffic with which the controller can successfully deal. These "selectors" provide for calling 150 distinct stations, but on an ordinary control circuit, 20 to 40 stations usually constitute as many as one controller can generally handle satisfactorily.

In front of the controller a case is provided with one key for each point to which he requires to communicate. The key for lines up to fifty stations consists of a clockwork mechanism controlled by a silent governor, which, by means of a toothed wheel, makes and breaks an electrical contact. An adjustable guard is provided to cover or expose more teeth as required, the number of teeth exposed, and consequently the number of electrical impulses sent, differing for each station. Above fifty stations a group system is introduced. The stations are divided into groups of fives, one of which is first selected and afterwards the particular station of that group. The key is modified to provide two adjustable shields to expose the teeth in the two groups required.

At each of the stations a special telephone set is provided. These sets are all normally in bridge across the pair of telephone lines so that it is only necessary to lift the receiver from its hook, and speak into the transmitter to communicate with the controller. The station is called by a trembling bell brought into action by the selector mechanism, which is operated by the controller's key. This selector consists of a toothed wheel, carrying one or more contact arms, which is stepped round against the action of a light spring by a stepping pawl operated by an electric magnet whose armature keeps step with the impulses sent out by the key. A second electromagnet arranged to act sluggishly, controls a retaining pawl which prevents the toothed wheel from flying back between the impulses. This electromagnet also brings the stepping pawl into its active position. This magnet is energised immediately the key is operated and remains energised until the station has been called, when it allows the selector to return to its normal position.

When any key is operated all the selectors on the line are stepped round in unison. The contact arms carried by the toothed wheel are spaced at different positions and correspond with the number of impulses sent out by the particular key associated with the particular station, and are closed in sequence as the selectors step round. Thus on the first impulse, selector No. 1's contact is closed, and on the second impulse selector No. 2's contact is closed, and so on. However, the key operates so rapidly that the contacts are closed only for a small fraction of a second, much too short a time for the

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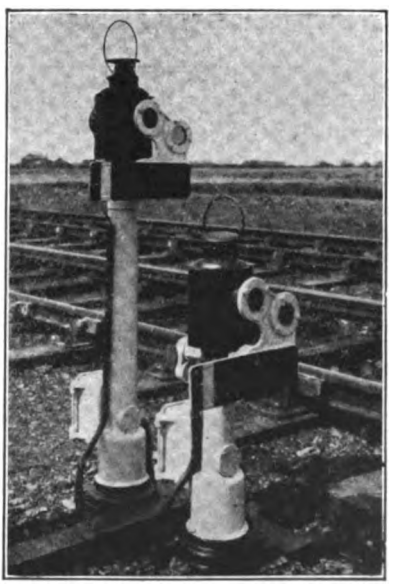
trembling bell connected with the contacts to operate. When the shield over the key teeth is reached, the particular contacts closed at this time will remain closed for two or three seconds, during which time its bell will ring. No other contacts being closed, no other bell will ring. The arrangement of the circuit is such that the interrupted current of the ringing bell will affect the controllers' receiver and enable him to hear distinctly that the bell is actually ringing.

These are the essential features of the system, but in practice additional apparatus is required. A battery of dry cells or small accumulators is provided to operate the selectors. The voltage of this battery is determined by the length of line and the number of stations connected, and may vary from 80 to 350 volts. As it is desirable to avoid sparking at the key contacts as much as possible, this battery is connected to line by means of a telegraph relay, and the keys are in a local circuit, including the relay coils and a small battery. Condensers are used to bridge the contacts to reduce sparking, and retardation coils are inserted to prevent the sudden rush of current, which would result from connecting the large battery direct to line, and would cause unpleasant noises in the controller's telephone. A foot switch is frequently provided to enable the controller to open the local battery circuit feeding the transmitter, to prevent waste when listening, or when the circuit is out of use. When the arrangements are such that the controller may not always be listening on the line, a generator is fitted at important stations, and a magneto bell at the controller's office.

The telephones at the stations are of special construction in order to provide the high impedance bridge necessary, when so many stations may be simultaneously listening across one pair of lines. They are fitted with high efficiency induction coils and high impedance receivers, and the instrument is provided with a key by means of which the circuit may be arranged to give the greatest speaking efficiency when the key is in one position and the greatest receiving efficiency in the other. An impedance coil is introduced in series with the receiver in the speaking position to further increase the effective resistance of the bridge and improve the transmission.

In some cases a message wire system is installed. The apparatus required for this is generally similar to that provided for the controller's circuit, but it is arranged for inter-communication calling, that is, each station can signal all the other stations individually, and there is no controller. Instead of fitting each station with a complete set of keys, one special key only is provided, which has its shield connected by means of suitable gear, to a handle with an index finger. When the finger points at the first name plate, the one tooth necessary to call selector No. 1 is exposed; when at the second, the teeth necessary to call selector No. 2 are exposed, and so on. This key has a maximum capacity for 50 stations. The message wire can be used as an adjunct to the controller's circuit, enabling important junctions or chief officers to communicate with one another, and it is found a most satisfactory means of communication between storekeepers, between termini, sidings, and engine sheds, and other locations which will readily occur to those familiar with railway working.

In the train control offices the controllers are assisted, as several times described in these pages, by large diagrams of the railways in the area covered, with devices whereby the movements of trains and engines can be graphically recorded. On one railway an ingenious addition is made, there being provided on the diagram, for each station or siding, a revolving plug making one revolution per hour, all being operated from a suitably connected motor. The



ALL-ELECTRIC DWARF SIGNALS.
British Pneumatic Railway Signal Co., Ltd.

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controller attaches the indicator for a train or engine thereto, and as the plug revolves slowly a pointer shows at a glance by its position how long a train or engine has been standing there, thus providing useful information to the controller, without it being necessary for him to refer to his records or notes.

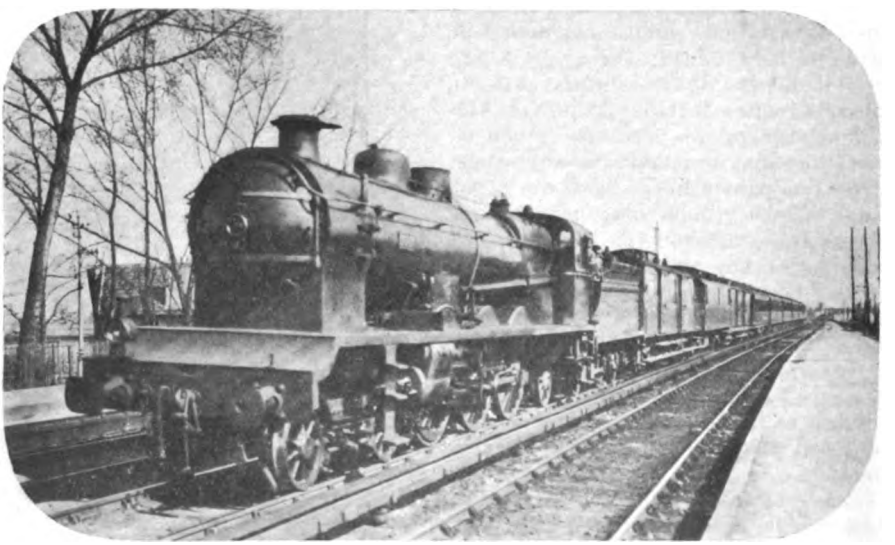
For general purposes, too, the telephone is now an essential to practical railway operation, and inter-communication systems are generally in use, not only at chief and district offices, but also at many depôts where it is found convenient to thus link up even as few as ten or a dozen departments and private rooms.

In conjunction with signalling it is a usual practice to employ indicators of various types. In fact the standard block instruments, as well as special forms, nearly all combine an indicating portion, to show "Section clear," "Section blocked" "Train on Line," "Train entering section," "Train out of section" or the like; while in other cases indicators are employed to show class or destination of train coming, occupancy of particular lines or platforms (operated either by track circuits or track contacts), platform at which a train will arrive (operated in the signal cabin for the information of the staff and the public at a terminal or other important station), and occasionally for instructions to station staff. Recorders are sometimes combined with such indicators, but this is not very general.

Of another class are the special train indicators as employed on the Underground railways, including the progressive train describers as used on the Metropolitan District, train indicators as installed at Baker Street, Metropolitan Railway, the "non-stop station" indicators on the London Electric Railway, and indicators to show the platform from which the next train starts as used at Underground stations and also to some extent at many-platformed stations, such as Clapham Junction.

Of a further class may be noted the illuminated diagrams used in conjunction with power signalling to show the condition of each track, thus relieving the signalman of most of the standard messages, and also obviating the use of repeaters and other indicators where a signalman cannot see every train under his control. Repeaters for signals out of sight, "light in" and "light out" indicators for signal lamps, "engine standing" indicators, and other devices are also among the many developments found in signal cabins.

EXPRESS TRAIN ON THE PARIS-ORLEANS RAILWAY.



Photo] [*H. Macartney Robbins.*

4-6-2 Locomotive No. 3525, on Up Express, near Paris.

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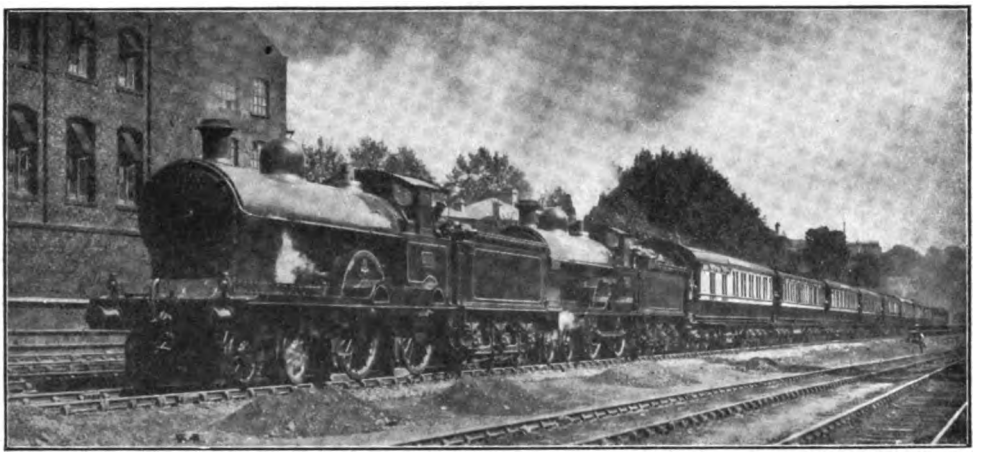

Photo] [*F. E. Mackay.*

LONDON AND NORTH WESTERN RAILWAY.

2 p.m. Scotch express passing Camden; 4-4-0 locomotives Nos. 2166 *Shooting Star* and 228 *E. Nettlefold* (Schmidt superheater).

British Locomotive Practice and Performance.

By CECIL J. ALLEN.

EXACTLY two years ago this month I gave a *résumé* of locomotive performance over the London and North Western Railway between Crewe and Carlisle. At that time the "Claughton" class engines had not commenced to run, while the number of superheater locomotives of the "George the Fifth" and "Prince of Wales" classes at work was but limited. As a matter of fact, only six out of the fourteen runs described were made behind superheater-equipped engines. I wish now, therefore, to supplement that table by a further one, dealing entirely with the work of the three superheater classes just mentioned over this interesting stretch of line. I have tabulated herewith a series of runs that I have made behind superheater engines on this section as between Preston and Carlisle, and a more striking tribute to the working efficiency of modern Crewe productions it would be hard to imagine.

It will be seen that the table gives, in all, details of ten runs between Preston and Carlisle. With the exception of No. 4, they all relate to the 2.0 p.m. express *ex*-Euston, leaving Preston at 6.24 p.m., and covering the 90 miles to Carlisle, start-to-stop, in 104 minutes, at an average speed of 51·9 miles per hour. No. 4 run was made on the Liverpool and Manchester morning Scotch express, leaving Preston at 10.55 a.m.; this is usually a much lighter train, and is only allowed 102 minutes, the speed in this case working out at 52·9 miles per hour. Of these runs, Nos. 1 to 3 were made behind 4-4-0 engines of the "George the Fifth" type, Nos. 4 to 6 behind 4-6-0 engines of the "Prince of Wales" type, and on the last four—Nos. 7 to 10—the engine employed was the pioneer 4-cylinder 4-6-0, No. 2222, *Sir Gilbert Claughton*. The loads on the 6.24 p.m. *ex*-Preston are consistently heavy, but on only one of the nine runs tabulated was a pilot taken; the average unpiloted load (excepting runs 4 and 6) was 48½ axles, or approximately 350 tons, including passengers and luggage. Yet in only one single instance was time lost, and this was due to the fact that a dead stand for signals, for no less than 4¾ mins., was encountered at Milnthorpe—just about the worst possible "strategic" point, seeing that this is the foot of Grayrigg bank, where speed should rule high.

Let two facts be emphasised here: first, that these are *all* my runs on this particular train behind superheater engines, and, second, that the gross times, with the one exception mentioned, are all as booked or

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L. & N.W.R.—6.24 p.m. Preston-Carlisle.

Distance (miles).	Run No.		Schedule Times (mins).	1	2	3	4†	5	6	7	8	9	10
	Engine Type			2-Cylinder 4-4-0			2-Cylinder 4-6-0			4-Cylinder 4-6-0			
	Engine No. / Engine Name			2663 *George the Fifth*	2242 *Meteor*	1188 *Penmaenmawr*	2198 *John Ruskin*	819 *Prince of Wales*	Piloted* 362 *Robert Southey*	2222 *Sir Gilbert Claughton*			
	Load (axles)			48	50	54	32	46	58	42	44	50	54
	Load Empty (tons)			330	346	372	217	316	401	290	302	348	374
	Load Full (tons)			345	360	390	225	330	420	305	315	365	390
—	Preston	dep.	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4¾	Barton	pass	—	8.40	8.00	8.20	7.55	8.05	7.45	7.35	7.40	8.10	8.10
12¾	Scorton	,,	—	16.20	15.10	16.40	15.20	15.45	15.40	15.10	15.00	15.25	15.35
21	Lancaster	,,	23	24.00	22.40	25.10	22.55	23.25	24.00	23.15	p.w.s. 23.10	23.00	23.30
27¼	Carnforth	,,	30	29.15	28.30	30.30	28.15	29.00	29.30	28.40	31.10	28.40	29.00
34½	Milnthorpe	,,	—	36.15	35.30	37.30	35.25	36.25	36.45	35.50	38.05	36.15	Signal stop sigs.
40⅜	Oxenholme	,,	44	42.35	41.35	43.50	42.25	43.10	43.00	41.50	44.00	42.45	54.45
47⅛	Grayrigg	,,	—	53.40	52.35	55.05	53.05	54.40	53.35	50.25	54.40	54.15	65.45
53⅓	Tebay	,,	62	60.20	59.40	61.40	59.20	61.05	60.00	57.50	61.25	60.55	73.00
58¼	Shap Summit	,,	72	70.20	70.30	72.15	68.15	69.30	70.15	67.00	71.30	70.35	82.35
60¾	Shap	,,	—	72.55	73.20	75.15	70.50	72.15	73.20	69.50	74.20	73.35	85.25
72½	Penrith	,,	86	84.05	83.50	85.05	p.w.s. 84.00	83.35	83.20	81.10	85.40	84.45	95.40
79⅜	Calthwaite	,,	—	90.40	90.55	92.15	90.55	90.20	90.35	88.55	92.35	91.50	102.15
85½	Wreay	,,	—	95.40 sig. stop	95.35 sigs.	97.30 p.w.s.	96.05 sigs.	95.05 sigs.	95.50 sigs.	93.15 sigs.	97.30 sigs.	p.w.s. 97.00 sigs.	107.20 p.w.s.
90	Carlisle	arr.	104	103.25	102.40	103.55	102.15	101.50	103.05	100.40	104.05	104.25	113.35
90	Net times (mins.)		104	100¾	100¾	102¾	99¼	100¼	101	98¼	100	101¾	100¼
7¼	Carnforth-Milnthorpe		14	7.00	7.00	7.00	7.10	7.25	7.15	7.10	6.55	7.35	—
5⅝	Milnthorpe-Oxenholme			6.20	6.05	6.20	7.00	6.45	6.15	6.00	5.55	6.30	—
7	Oxenholme-Grayrigg		18	11.05	11.00	11.15	10.40	11.30	10.35	8.35	10.40	11.30	11.00
6	Grayrigg-Tebay			6.40	7.05	6.35	6.15	6.25	6.25	7.25	6.45	6.40	7.15
5⅝	Tebay-Summit		10	10.00	10.50	10.35	8.55	8.25	10.15	9.10	10.05	9.40	9.35
31¼	Total		42	41.05	42.00	41.45	40.00	40.30	40.45	38.20	40.20	41.55	—

† 10.55 a.m. Preston to Carlisle. * Pilot: 2-4-0 No. 2002, *Madge*.

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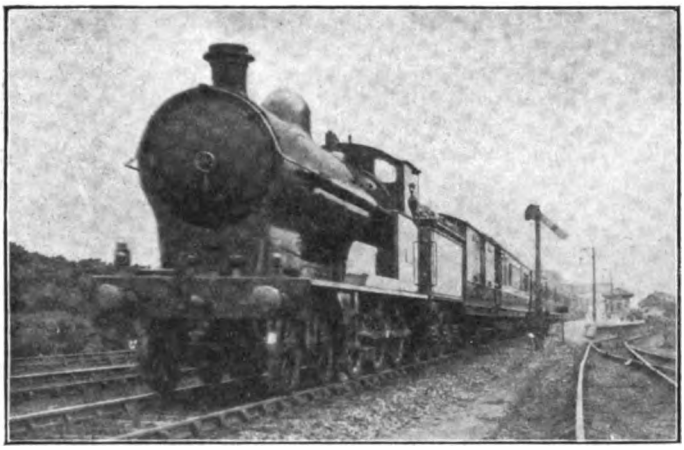


Photo] [*Rev. H. A. T. Viener.*

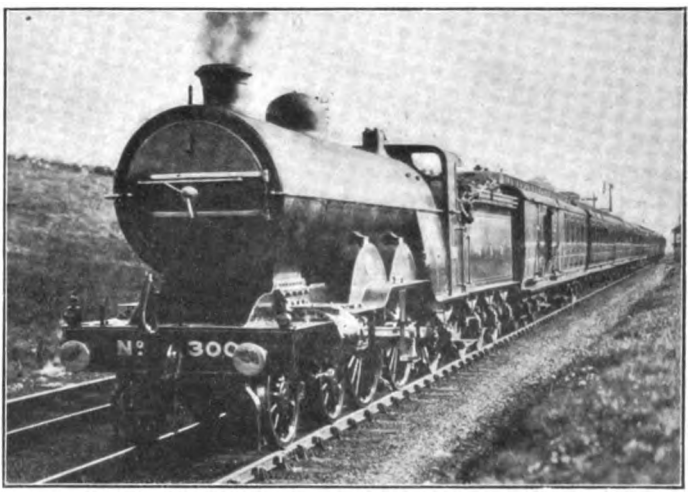
LONDON AND NORTH WESTERN RAILWAY.

Express passing Garstang.

within schedule, although inclusive of delays. Net times show an average gain of 3½ mins. per trip to the engines. More important still is it to notice that, with the same one exception, every engine either kept or improved on the uphill time of 42 mins. from Carnforth to Shap Summit, which, with its average of 45 miles per hour, does not err on the easy side with a train of this weight. Even better work would probably have been recorded were it not for the consistent punctuality with which the train almost always reaches Preston, when I am intending to time it, and I have often sighed in vain for the late arrival that might afford a pretext for real record-breaking Most of the honours in the table go to *Sir Gilbert Claughton*, whose work is always of the very first water.

A few words may first be devoted to the gradients. The start from Preston is on a short grade of 1 in 95, so that the setting in motion of a heavy train of this character is none too easy a task. Following this come 3 miles of slight ascent, at 1 in 500, to near Barton, and then a stretch of 17 miles almost dead level throughout. Through Lancaster there is a sharp fall for 1½ miles at 1 in 95, followed by a more gradual descent to the sea-shore at Hest Bank; thereafter succeed slight undulations to a point about 1¼ miles beyond Carnforth. Then comes a steep climb of 2¼ miles at 1 in 131, a short descent of 1½ miles at 1 in 280 to Barton, and a level 2 miles to the crossing of the small stream about ½ mile south of Milnthorpe station. This is the foot of Grayrigg Bank. From Milnthorpe to Grayrigg stretches an unbroken 13 miles' ascent, commencing at 1 in 175, 103, 400, 109, and 182 to Oxenholme station, and continuing at 1 in 105, 120, 133 (2 miles) and 106 (also 2 miles) to Grayrigg Summit.

A short "breathing space" of 5¾ miles ensues, but little easier than level, and we have then the final climb to Shap Summit, commencing with 1¾ miles at 1 in 147, and finishing with 4 miles at 1 in 75. The most interesting part of the north-bound journey is therefore the 31½ miles separating Carnforth and Shap Summit, in which the trains are lifted from what is all but sea-level to an altitude of 915 ft. above the sea. Special particulars of the climbing are given below the table of the runs. Beyond Shap Summit the line falls sharply throughout to Carlisle,



Photo] [*F. E. Mackay.*

GREAT NORTHERN RAILWAY.

10 a.m. Scotch express; 4-4-2 locomotive No. 300.

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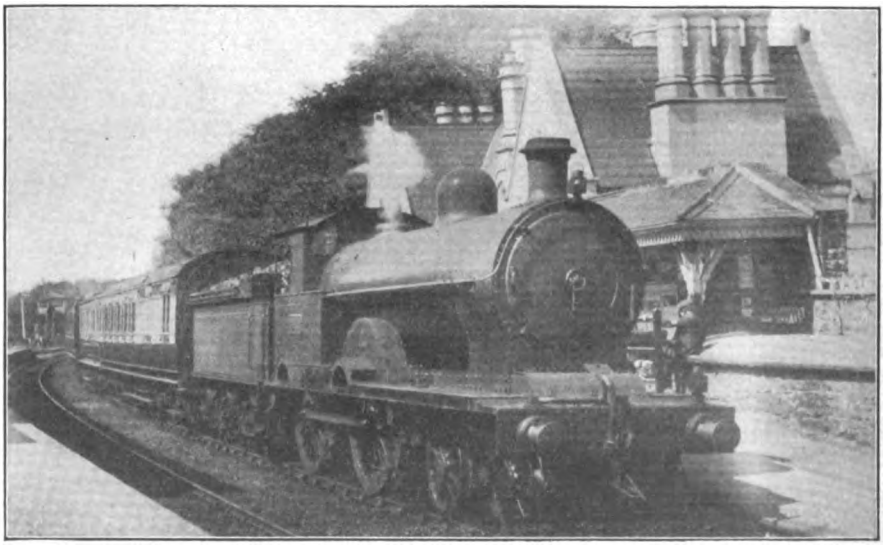
with the exception of a stretch of line extending from a point 4 miles south of Penrith to one 5½ miles north of that town; this is not so steep, and is broken by short sections of level track. As we shall see, drivers but rarely avail themselves of these falling grades in order to gain time, the speed over them being almost invariably kept at a studiously, and sometimes unnecessarily moderate figure.

Without further preliminaries we come now to the runs themselves. The first three were made with engines of the 4–4–0 "George the Fifth" type, and were all runs of particular merit. On No. 1, behind *George the Fifth* itself (this run has been described previously in these columns), the start was inclined to be slow, but an exceptional feature of the journey was the high speed from Lancaster to Carnforth on which a maximum rate of 75 miles per hour was touched. As a result of this the minimum speed on the short ascent to Barton was as high as 56·3 miles per hour, and the maximum before Milnthorpe 65·2, taking us through Oxenholme well before time. Up Grayrigg Bank the minimum speed was 32·9 miles per hour, and up Shap, where the engine was not at all forced, 22·5, with a top speed at Tebay of 65·2 miles per hour. The descent to Carlisle was taken at a moderate rate, but a signal stop approaching Carlisle caused us to lose 2½ mins.; nevertheless the arrival was within booked time. This signal delay, as will be seen, occurred with more or less severity on nearly every run on which the train was running to time, and might generally, I should imagine, be traced to the Edinburgh portion of the Midland 1.30 p.m. *ex*-St. Pancras, which does not leave Carlisle until 8.3 p.m., or 5 mins. before the London and North Western train is due, starting from the same platform. In estimating the cost of delays north of Wreay, by the way, I have calculated on a net time of 5¼ mins. from Wreay to Carlisle stop. This is the average time of my unchecked runs, although I have on several occasions noted faster finishing times than this.

In respect more particularly of the start, No. 2 was a remarkable trip. At Brock troughs, beyond Barton, the speed was 70·3 miles per hour, and, despite a decided slack through Lancaster—to 50 miles per hour—and a maximum of only 68·1 at Hest Bank, the minimum speed at Barton was as high as 54·9 miles per hour, and the highest rate at the foot of Grayrigg Bank was 65·2 miles per hour. On passing Oxenholme, therefore, nearly 2½ mins. had been gained. The ascent of Grayrigg Bank was quite good, with a minimum speed of 31·3 miles per hour, but as the train was now early, the running up Shap was decidedly leisurely, the lowest rate being 19·4 miles per hour at the summit. Descending to Carlisle the maximum speed



Photo] [*J. Macartney Robbins.*

LONDON AND NORTH WESTERN RAILWAY.

Holyhead-Chester train at Menai Bridge; 4-4-0 locomotive No. 2031 *Delamere.*

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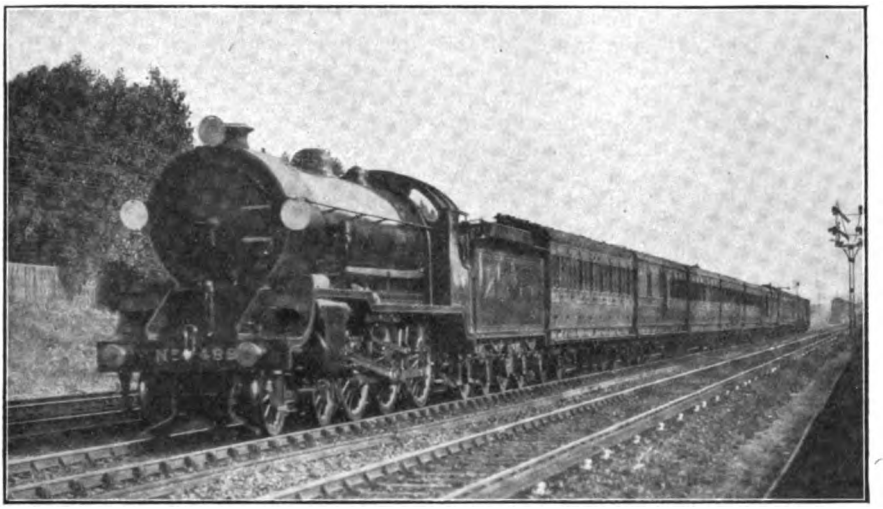

Photo] [*F. E. Mackay.*

LONDON AND SOUTH WESTERN RAILWAY.

Up Bournemouth express ; new 4–6–0 superheater locomotive No. 489.

near Clifton was 78·9 miles per hour, but several slacks were made, including one of exemplary caution at Penrith to 40 miles per hour. Still, with the usual check outside Carlisle, we arrived comfortably within booked time.

No. 3 was a plucky effort with a tremendous load. The start was necessarily slower than on the preceding runs, but *Penmaenmawr* did well to tie with the times of *George the Fifth* from Lancaster to Oxenholme, and to beat those of *Meteor* by 15 secs. A maximum speed of 73·8 miles per hour was touched at Hest Bank, and of 65·2 at Milnthorpe, the intermediate short rise to Barton lowering the rate to 52·9 miles per hour. The ascent of Grayrigg Bank was magnificent, considering the load : at the end of the 1 in 133 the speed was 37·5 miles per hour, and it did not fall finally to less than 33·1 on the 1 in 106. So time was kept from Carnforth to Tebay—a noteworthy achievement. From Tebay to Shap Summit the work fell off slightly, the lowest speed on the 1 in 75 being 19·0 miles per hour, but we passed the Summit box almost exactly on time. A very brisk descent was made from here to Penrith, speed rising first to a steady 81·8 miles per hour, and then further to a sustained 83·3 past Clifton. And really it must be confessed that the travelling at this speed, over a track perfectly adapted and super-elevated for very fast running, was smoother than one frequently experiences on the same stretch of road at much more moderate speeds. Thus we had a minute in hand at Penrith, and reached Carlisle dead on time, despite a permanent way check at Wreay.

On the next three runs 4–6–0 2-cylinder engines of the " Prince of Wales " class were employed. As indicated in the table, the first of these (No. 4) was timed on the 10.55 a.m. express *ex*-Preston, with a comparatively light load. The timing of this train corresponds almost exactly with that of the 6.24 p.m., save for the allowance of 17 mins. instead of 18 from Oxenholme to Tebay, and 9 instead of 10 from Tebay up to Shap. Thus the overall time is curtailed by 2 mins. Good, but not exceptional running was made, schedule times being closely adhered to. At Brock troughs the speed was 69·2 miles per hour, and at Hest Bank 73·8, bringing us 1¾ mins. before time at Carnforth. Thence we lost 10 secs. to Oxenholme, gained 5 secs. to Tebay and another 5 to Shap Summit, making the total time from Carnforth to Summit exactly 40 mins. as booked. The lowest speed on Grayrigg Bank was exactly 40 miles per hour, and on the ascent of Shap 29·4. From the summit to Carlisle the running was very cautious, and, hindered by a permanent way slack and a signal check, we arrived 15 secs. late, but the net time was well within schedule.

No. 5 run was described in the article of two years ago, and was made with the pioneer engine of this type—*Prince of Wales*—very shortly after its construction. Here again the adherence to booked times was very strict until after the train had

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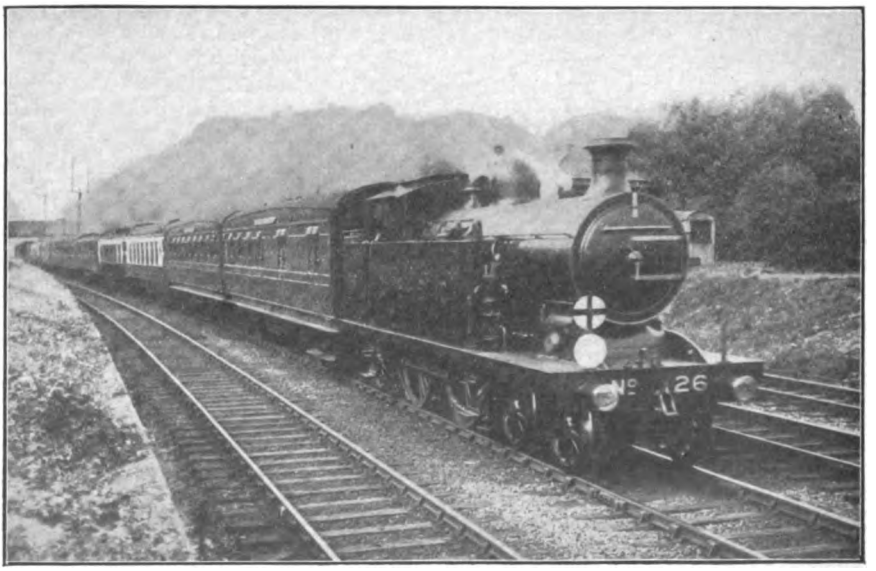
passed Tebay, when a brilliant ascent was made to Shap Summit—the fastest of the whole series. In fact, it is the fastest I have ever timed personally with as heavy a load as this, although of course it does not approach the record time of *Sir Gilbert Claughton* on the 6.40 p.m. down with only 20 tons less, when the climb was accomplished in 6 mins. 41 secs. On Grayrigg Bank the minimum speed was 36 miles per hour, and up Shap 28·5. The maximum speeds were not excessive, being 65·2 miles per hour at Brock, 69·2 at Hest Bank, 65·2 at Tebay, and 75 both near Clifton and beyond Calthwaite. So again time was improved on without difficulty.

In the last of these three runs, most unfortunately, a pilot was provided: I had hoped against hope that the engine might be allowed to try her unaided powers on this vast train. But a load of " =20 " was too great, and it was thus impossible to make the comparison that I was anxious to with runs 3 and 10. In consideration of the piloting, the running was quite undistinguished; the best feature was the time of 36 mins. for the 32½ miles from Lancaster to Tebay—a gain of 3 mins. on schedule. The minimum speed on Grayrigg Bank was 36·9 miles per hour, but going up Shap we fell to 20·7. But a good feature of the run was the starting time of 7¾ mins. from Preston to Barton. The highest speeds at Brock and Hest Bank were only 63·8 and 69·2 miles per hour respectively, but quite a brisk descent was made from Shap to Penrith, speed being maintained at 80·3 miles per hour for some distance.

Now we come to the runs behind No. 2222, *Sir Gilbert Claughton*, the pioneer 4 cylinder 4–6–0, and a fine collection they make, reflecting the greatest credit on driver Ford, of Crewe, for his consistently able handling of the engine. No. 7 was an exceedingly fine run, made after the mileage of the engine, without any heavy repairs, had run into six figures. In the first place the starting time of 7 min. 35 sec. to Barton was the fastest I have yet recorded, but then the engine was eased a little, speed not exceeding 65·2 miles per hour at Brock, and 71·4 at Hest Bank. The minimum speed at Barton was 56·3 miles per hour, and the maximum at Milnthorpe 63·8; after this the main effort was made. Oxenholme, after 6 miles of steep climbing, was passed at 50·5 miles per hour, and the lowest speed at Grayrigg Summit was actually 42·4 miles per hour. This does not, of course, touch my previous record with the same engine and an almost identical load, when a speed of 47·9 miles per hour was attained on the 1 in 133 after starting *from rest* at Oxenholme, and a rate of no less than 46·4 miles per hour was maintained on the final 2 miles at 1 in 106. But this occurred when the



Photo] *H. E. Ambrose.*

LONDON, BRIGHTON AND SOUTH COAST RAILWAY.

Down Brighton express; 4-4-2 superheater tank engine No. 26.

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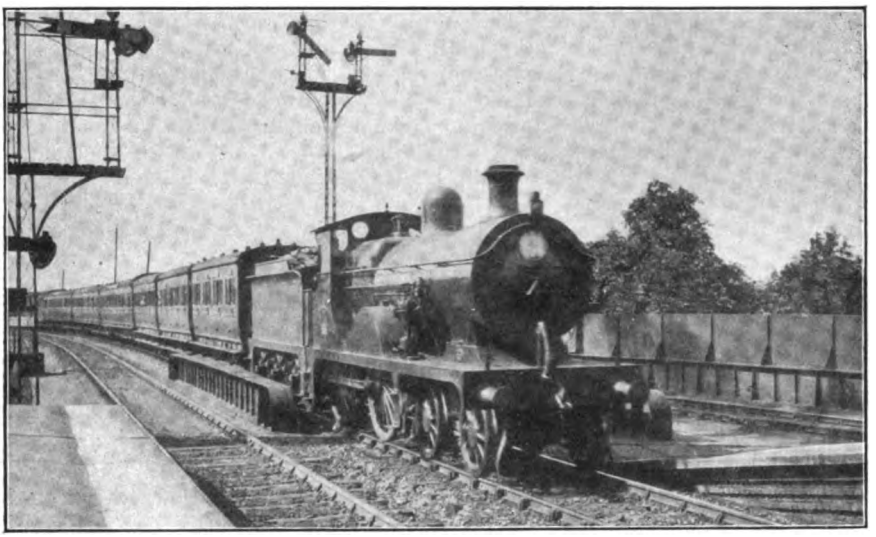

Photo] [*E. A. Gurney-Smith.*

SOUTH EASTERN AND CHATHAM RAILWAY.

2.40 p.m. Victoria-Ashford train passing Shortlands ; 4–4–0 locomotive No. 516.

engine was fresh from the shops. In any case, this magnificent ascent gave me the fastest times I have ever recorded between Oxenholme and Grayrigg—faster, indeed by 1½ min. than any of the times given in these columns 2 years ago with equivalent loads, and 40 sec. faster than the time of the 2-cylinder 4–6–0 *Defiance* with 270 tons. After breasting Grayrigg Summit we were so greatly in advance of time that no further effort was made ; we did not even reach the mile-a-minute rate at Tebay, and fell to 29·1 miles per hour on Shap, but even then we passed Shap Summit a modest 5 min. early ! The remainder of the journey was, naturally, devoid of interest by comparison.

No. 8 run was my first experience behind *Sir Gilbert Claughton*, and has been described previously in the June issue of 1912. Once again the start was very swift, the time to Barton being noteworthy ; at Brock the speed was 68·1 miles per hour, but this increased to 71·4 on the level or faintly rising stretch beyond. Through Lancaster we suffered a very severe signal check, and the way that the engine recovered from this delay was the main feature of the run. At Hest Bank the speed was only 60 miles per hour, but, accelerating rapidly on the level, we passed Carnforth at 68·1, only fell to 57·0 at Burton, and actually attained a speed of 69·2 miles per hour on the short descent to Milnthorpe. The ascent of Grayrigg Bank also, although falling short by over 2 min. of the time on the preceding run, was very good, speed not falling below 38·1 miles per hour. Consequently all arrears of time had been regained on passing Tebay, where the speed was 64·3 miles per hour, and driver Ford then legitimately eased his engine on Shap incline, the minimum speed at Shap Summit being 23·1 miles per hour. The descent to Carlisle was made at a moderate rate, and had the usual signal check in conclusion, but allowing for both delays the net time did not exceed 100 min.

Of the "Claughton" series the most featureless, comparatively speaking, was No. 9. The train was dead on time from the start, and the driver was content to keep closely to schedule throughout, only gaining, as usual, on the somewhat overtimed stretch from Lancaster to Carnforth. The maximum speeds at both Barton and Hest Bank were 70.3 miles per hour, but at Barton the rate fell to 48·4, while the highest speed at Milnthorpe was 63·8 miles per hour. Leisurely ascents were made of both Grayrigg and Shap inclines, speed falling to 32·6 miles per hour in the former case, and 23·1 in the latter, but dead time was kept from Carnforth up to Shap Summit. Owing to a permanent way slack at Wreay in addition to a signal check beyond, the arrival at Carlisle was slightly behind time, but of course the net time was well within schedule.

The last run of the series—No. 10—was

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a remarkable trip, on which a very heavy load was conveyed. At Brock the speed was 69·2 miles per hour, and at Galgate the rate had not fallen below 63·8, but a perceptible slack was made through Lancaster. At Hest Bank the maximum speed was 73·8 miles per hour, and Carnforth was passed with a minute in hand. Up the short bank to Barton the minimum speed was 49·5 miles per hour, and we were then approaching Milnthorpe at 64·3 when adverse signals were sighted. In hopes of avoiding a dead stand, Ford brought the train to rest very slowly, so that the net time for the 34½ miles from Lancaster to Milnthorpe should be about 37 min., against so that *Sir Gilbert Claughton* had performed the remarkable feat of passing Oxenholme slowly, and yet keeping time with a load of 390 tons from Oxenholme to Shap Summit. The descent to Carlisle was more brisk than usual, a speed of 77·5 miles per hour being attained at Clifton, and one of 80·3 beyond Calthwaite, although we had a very bad relaying check at Wreay. Our net time of 100½ min., therefore, makes this a very creditable run indeed.

Needless to say, the uphill figures of runs 7 to 10 are entirely put in the shade by the record trip behind *Sir Gilbert Claughton*, which was described in the January issue of last year. The load on that occasion was

Distance.	10.30 A.M. Ex-Euston.		Schedule.	1721 *Defiance*	2279 *Henry Crosfield*	Schedule.	5.30 P.M. Ex-Euston. 1595 *Wild Duck*	1417 *Landrail*	1733 *Grouse*
	Engine No.								
	Engine Name								
	Type (superheater) ..			4-6-0	4-4-0		4-4-0	4-4-0	4-4-0
	Load (axles)			54	57		50	54	57
	Load (tons)			405	420		370	400	415
Miles.			Mins.	†		Mins.			
—	Euston	dep.	0	0.00	0.00	0	0.00	0.00	0.00
5¼	Willesden ..	pass	9	12.15	10.00	9	9.20	11.20	9.50
17¼	Watford	„	23	27.40	23.10	22	22.00	23.55	22.10
31⅝	Tring	„	40	43.55	38.25	37	37.30	38.45	36.45
46⅝	Bletchley ..	„	55	57.50	52.05	51	51.00	51.55	50.00
59¾	Roade	„	68	70.35	65.00	64	63.20	64.05	62.30
82¾	Rugby	„	91	93.20	87.05	87	86.05	86.00	85.20
97	Nuneaton ..	„	107	109.45	104.35	104	103.15	102.50	101.55
110	Tamworth ..	„	119	121.40	116.10	117	115.00	114.20	114.15
124¼	Rugeley ..	„	133	135.45	129.50	132	129.20	128.30	128.55
133½	Stafford.. ..	„	143	145.30	139.20	142	sigs.	139.30	140.25
							severe		
147¼	Whitmore ..	„	—	161.00	157.00	—	—	—	—
158	Crewe	arr.	171	172.45	168.15	—	—	—	—
—	Net times (mins.) ..		171	168¾	168¼	142	140½	139½	140½

† Fog throughout journey; very thick to Tring, with cautious running.

37 min. 40 sec. actual, start-to-stop—a smart piece of work with a train-load of 390 tons.

We were kept standing for 4¾ min., and were then again checked badly at Hincaster Junction. So Oxenholme was passed at a speed very much below normal. Yet the big engine accelerated on the steep grades beyond to 39·5 miles per hour, falling finally to 33·6 on the 1 in 106; under these conditions, of course, the time of 11 min. from Oxenholme to Grayrigg was exceptionally fine. On to Tebay the running was unaccountably slow, no higher speed than 57 miles per hour being touched, but the lowest rate up Shap was 25·7 miles per hour, 310 tons behind the tender, and the train the 6.40 p.m. *ex*-Preston, calling at Carnforth, Oxenholme and Penrith. Starting on the grade at Oxenholme, Grayrigg was actually passed in 10 min. 54 sec., at a speed of 46·4 miles per hour, speed having risen to 47·9 miles per hour on the 1 in 133. The short level stretch to Tebay, which was passed in 5 min. 36 sec. from Grayrigg, produced the tremendous maximum of 75 miles per hour, and we then went up the 1 in 75 of Shap without the speed falling below 38·1 miles per hour. From Tebay to Shap Summit the time was a truly record one of 6 min. 41 sec.; from Oxenholme start to Shap Summit, 18⅝ miles, with a clear rise

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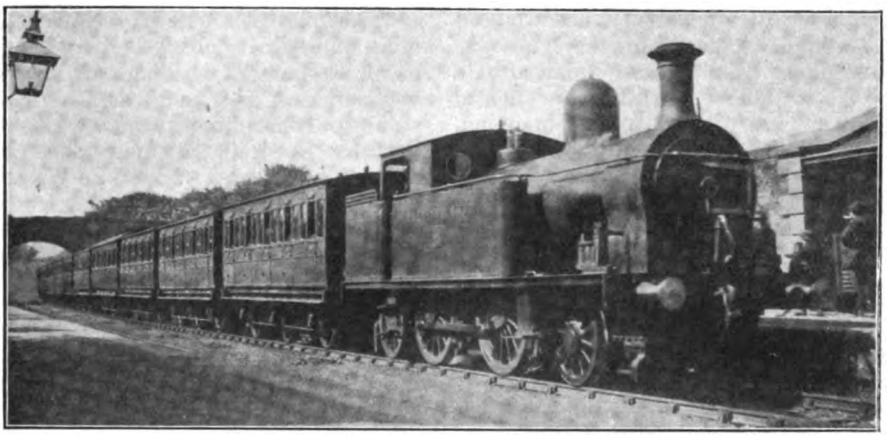

Photo] [*H. H. Coghlan.*

DUBLIN AND SOUTH EASTERN RAILWAY.

Local train at Shankhill ; 2-4-2 tank engine No. 46, *Princess Mary.*

of over 600 ft., the time had been only 23 min. 11 sec.—average 48·2 miles per hour from the start. This is 2 min. less than the fastest pass-to-pass time between these points in the table, the latter record also being one made by the same engine. This was, of course, a simply phenomenal effort, in every respect, but even the other four runs described behind *Sir Gilbert Claughton* speak volumes for the tractive capacity of this latest Crewe production.

Another recent " record " that I enjoyed in this direction was one on the Glasgow portion of the 10 a.m. *ex*-Euston. From the locomotive standpoint the work was not so meritorious as on most of the foregoing runs, as a pilot, working home, was provided throughout, with an only moderate load, but the times were truly " fierce." The engines were a superheater 4-6-0 of the " Prince of Wales " class—No. 981, *Sir W. S. Gilbert*—with No. 895, *Proserpine*, a 2-4-0 " Jumbo," as pilot. From Crewe there was a load of 36 axles, or 265 tons with passengers and luggage, but the train was 10 min. behind time. The start was very fast, Minshull Vernon, 5 miles (level throughout), being passed in 7 min. 10 sec., at 68·1 miles per hour, and Winsford, 7½ miles, in 9 min. 25 sec. Approaching Hartford, after 6 miles of faintly falling grades averaging about 1 in 400, the speed had risen to 77·5 miles per hour when we were badly checked for relaying. A further very decided slack was made for Weaver Junction, but at Moore troughs we touched 75 miles per hour, and were through Warrington, 24¼ miles, in 26 min. 40 sec., slacks included —20 sec. inside schedule. Approaching Wigan we were very badly checked by signals, and continued to crawl right through the station and for a distance of over a mile beyond at a speed not exceeding 15 miles per hour, waiting for successive signals to drop. This spoiled the ascent of Boar's Head Bank, and as the descent from Coppull to Preston was also moderate as to speed, with a very slow passage of the latter station, our total time from Crewe to Preston, 51 miles, was 61 min. 20 sec. But our delays up to this point were certainly not less than 8⅓ min., leaving a net time of 53 min. from Crewe.

From here real record-breaking began. Barton was passed in 6 min. 35 sec. from Preston, and the speed at Brock troughs was 73·8 miles per hour. Barton to Scorton took 6½ min., and Scorton to Lancaster 7 min., speed having at no point fallen below 71·4 miles per hour until we slacked to 65 through Lancaster. The total time from Preston to Lancaster was thus 20 min. 35 sec., and on to Carnforth we took 5 min. 20 sec., passing that station at 75 miles per hour. Up the 1 in 135 rise to Burton we never went below 63·8 miles per hour, and we then passed Milnthorpe at 70·3, having taken only 6 min. 20 sec. from Carnforth. Oxenholme was passed at 52·3 miles per hour, in 5¾ min. from Milnthorpe, the time of 37½ min. for the 40⅛ miles from Preston to this point showing a gain of 5½ min. on schedule time. Continuing up Grayrigg Bank we sustained a speed of 47·4 miles per hour on the 1 in 133, and fell to 45 exactly at the summit of the 1 in 106, passing Grayrigg in 8¾ min. from Oxenholme. Beyond Low Gill we were accelerating

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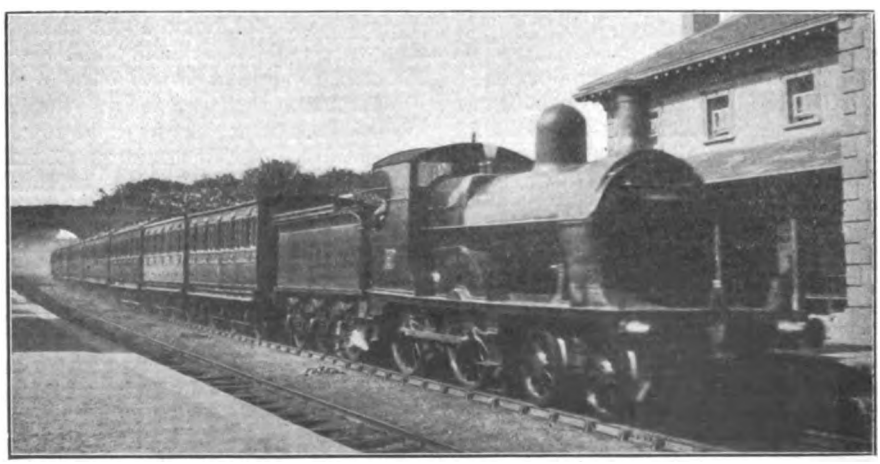
rapidly, and had already attained a speed of 64·3 miles per hour, when, alas! adverse signals brought us to a dead stand, after a slow stop, at Dillicar Box, 2 miles south of Tebay. This was positively heart-breaking, as our time over the most interesting part of the route was thereby ruined. We had covered the 51⅛ miles from passing Preston slowly to stopping at Dillicar in 52 min. 10 sec., or 51 min. net, allowing for the slowness of the stop.

We stood for exactly a minute, and then, getting away very smartly, we passed Tebay at about 45 miles per hour, and ran from there up to Shap Summit in the excellent time of 8 min. 5 sec., with no lower speed than 33·8 miles per hour. It is thus noteworthy that, inclusive of a stop costing fully 4 min., our time from Oxenholme to Tebay was only 18 min. 25 sec. From Shap Summit we ran under easy steam to Carlisle, the times being: from Summit to Shap station, 2 min. 20 sec.; from Shap to Penrith, passed very slowly, 11¼ min.; from Penrith to Calthwaite, 6 min. 25 sec.; from Calthwaite to Wreay, 4 min. 50 sec.; and from Wreay to Carlisle, with a bad signal check, 6 min. 10 sec. Thus we had run from Tebay (passed much slower than usual) to Carlisle, with the concluding slack, in 39 min. 5 sec., a further gain of 3 min., while the start-to-stop time from Dillicar to Carlisle, 38⅞ miles, was 41 min. 50 sec. inclusive. From Preston to Carlisle we had covered the distance of 90 miles, including all delays, in 95 min.—6 min. under booked time—and in 90 min., or "even time," net. From Crewe to Carlisle our gross time was 156 min. 25 sec., against a booking of 159 min., and this included the permanent way check at Hartford, the long and exceedingly bad series of checks through Wigan, the stop at Dillicar, and the check outside Carlisle, as well as unusually cautious running past Weaver Junction, Warrington, Euxton Junction, Preston, and from Shap Summit to Penrith. Allowing very carefully for the four definite delays, I estimate the net time throughout as 143 min. for the 141 miles, showing a gain to the engines of no less than 16 min.

On this particular occasion I was travelling through from Euston to Glasgow, and the whole journey constituted one of the most astonishing exhibitions of regaining lost time that I have ever recorded. From Euston we had a load of 11 of the latest eight-wheeled vehicles and two dining cars, weighing 405 tons empty, or 425 tons with a good complement of passengers and luggage. The engines were two non-superheater "Precursors," No. 645, *Mammoth*, and No. 665, *Mersey*. We first of all ran to Willesden, 5½ miles, in 10 min. 10 sec. Then we covered the 26⅛ miles from Willesden start to Tring in 31½ min., and had attained a rate of 71·4 miles per hour beyond Cheddington, when we were pulled up by signal at Sear's Crossing Box, 38 miles out, having covered the 32½ miles from Willesden in 37 min. 55 sec. After stopping 2 min. 5 sec., we proceeded, only to be stopped again, 6¾ miles further on, at Stoke Hammond Box, for 40 sec. Thence we made a very smart run to Rugby, passing Bletchley, 2⅛ miles, in 4 min. 20 sec.; Roade, 15¼



Photo] [*H. H. Coghlan*

DUBLIN AND SOUTH EASTERN RAILWAY.

Express train passing Shankhill; 4-4-0 locomotive No. 56, *Rathmines*.

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miles, in 17 min. 10 sec.; Welton, 30¾ miles, in 32 min.; and reaching Rugby, 38¼ miles, in 40½ min. The minima at Roade and Kilsby were each 56·3 miles per hour, and the maxima at Wolverton and Weedon 70·3 and 64·3 respectively. Although 6¾ min. had been lost on the 85-min. booking from Willesden, our net time for the 77¼ miles was 81 min., the engines having gained all but 3 min. from Bletchley alone.

A further fine effort commenced. from Rugby. Nuneaton, 14¼ miles, was passed in 17 min.; Tamworth, 27¼ miles, in 28 min. 10 sec. (at 72·5 miles per hour); and Rugeley, 41½ miles, in 41¾ min.—a further gain of 3¼ min. But once again adverse signals were encountered, and for the third time we were brought to a dead stand—at Colwich—after a long preliminary slack. The 44½ miles from Rugeley had taken 47 min. 20 sec., start-to-stop, or 46 min. net—another very smart "snippet." After stopping 1¾ min., we passed Stafford, 6¼ miles, in 10¼ min. (with a very careful slack to 40 miles per hour at Trent Valley Junction), and then went brilliantly up to Whitmore, the 14 miles taking only 15¼ min., with a speed at no time lower than 56·3 miles per hour. The last 10½ miles into Crewe took 10 min. 50 sec., with a sustained maximum of 77·5 miles per hour at Betley Road. From Stafford to Crewe the time of 26 min. 5 sec. was again very fine, the booked allowance being 29 min., and although the engines took 85 min. 25 sec. from Rugby to Crewe, the net time certainly did not exceed 77½ min., or 6½ min. less than booked. The total gain to the two "Precursors" was thus 10½ min. between Euston and Crewe, while, as we have seen, the "Jumbo" and the "Poet" together gained 16 min. thence to Carlisle—an aggregate of 26½ min. to London and North Western engines on one continuous journey. Further than this, the Caledonian superheater 4–4–0 engine which took the Glasgow train forward from Carlisle gained 5 min. on schedule without difficulty, no delays being experienced. Economy in stopping times accounting for another 1½ min., we thus had the extraordinary experience of arriving in Glasgow on time after a series of delays costing in the aggregate no less than 33 min.! The West Coast companies might justly feel proud of records of this character. A curious incident happened on this trip: the 10.30 a.m. *ex*-Euston arrived in Crewe a minute early, at 1.20 p.m., or 1¼ min. before we started away, so that it would have been possible on this day to make the journey from London to Glasgow in 7¾ hours.

Now that we are fairly "launched" on the London and North Western Railway, I may as well give the remainder of my recent experiences on that line, which are all worthy of note. One trip, made on the 4.7 p.m. Scotch express from Crewe to London, was more especially so. This train is booked to cover the 61 miles from Crewe to Nuneaton in 74 min. and the 97 miles thence to London in 106 min., slipping a coach at Bletchley—a curious reversal of the practice of previous years, when the train used to slip at Nuneaton and stop at Bletchley. On this occasion our engine was No. 361, *Beagle*—a superheater 4–4–0—and the load from Crewe 45 axles, 302 tons empty and 315 tons with passengers and luggage. The 10½ miles' climb to Whitmore was accomplished in 15 min. 50 sec., and Stafford, 24½ miles, was passed in 29 min. 10 sec., the speed past Norton Bridge being sustained at 67 miles per hour. After slacking at Trent Valley Junction, the 9¼ miles on to Rugeley took 11 min. 5 sec.; the 14¼ miles thence to Tamworth 13 min. 40 sec., with a maximum speed of 69·2 miles per hour at Hademore troughs; and the 13 miles from Tamworth to Nuneaton stop 14¼ min. From Crewe to Nuneaton, therefore, our time aggregated 68 min. 10 sec.—5 min. 50 sec. under schedule; although we had started 4 min. late. we thus arrived nearly 2 min. early.

At Nuneaton we attached the Bletchley slip coach, bringing up the load to 49 axles, or 340 tons in all. Shilton, 5¾ miles from the start, was passed in 8 min. 35 sec. despite the continuous rising grade, and we were through Rugby, 14¼ miles, in 17 min. 10 sec. from Nuneaton. We had attained a speed of 69·2 miles per hour at Brinklow, but slacked with undue caution through Rugby to 30 miles per hour. The 7½ miles from Rugby up to Welton took 9¼ min., and the 15½ thence to Roade 15 min. 10 sec., with a speed of 69·2 miles per hour at Weedon and 56·3 at Roade summit. Descending to Wolverton the speed was again 69·2 miles per hour, and the 13⅜ miles from Roade to Bletchley took 12 min. 40 sec. Relieved of the slip coach. *Beagle* ran from Bletchley to Tring, 15 miles, in 16¼ min., with a minimum rate of exactly 50 miles per hour at the summit, and then, with time well in hand, we simply ambled into Euston, taking 13 min. 35 sec. from Tring to Watford, 14¼ miles; 11 min. 40 sec. thence to Willesden, 12 miles, and 7 min 55 sec. for the

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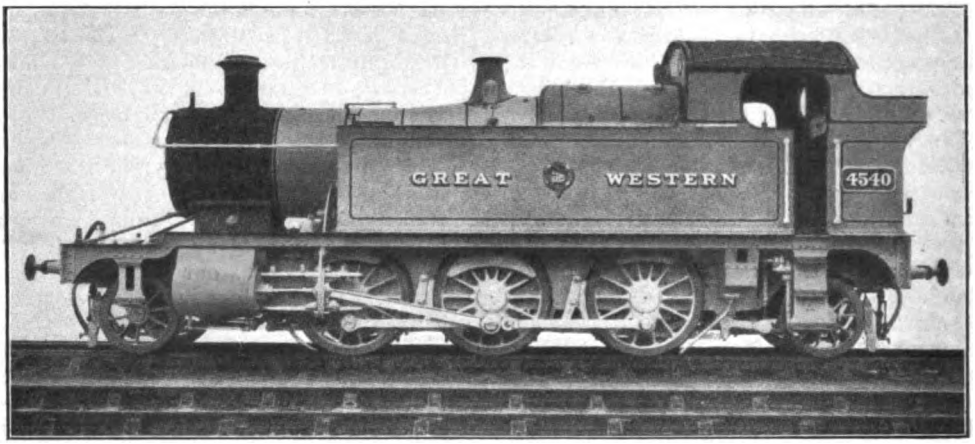
last 5½ miles into Euston. With the easiest of running, therefore, we had completed the journey from Nuneaton to Euston in 103 min. 40 sec., a total of 8 min. 10 sec. going to the credit of the engine between Crewe and Euston.

Two further runs in the same direction were characterised by very heavy loads. No. 2663, *George the Fifth*, had a really tremendous train, on the 3.20 p.m. *ex*-Crewe, of 59 axles (almost all the very latest stock) weighing 406 tons empty, and not less than 425 tons with passengers and luggage. Yet Whitmore was passed in 16 min. 40 sec., speed not falling below 40·6 miles per hour on the 1 in 177, and Stafford in 30¼ min., the maximum rate at Norton Bridge having been 69·2 miles per hour. From Stafford to Rugeley took 10 min. 55 sec.; Rugeley to Tamworth, 13 min. 50 sec. (with a maximum of 68·1 miles per hour at Hademore troughs); Tamworth to Nuneaton, 12 min. 50 sec.; and Nuneaton to Rugby, 16 min. Thus the 84-min. time from Crewe to Rugby, 75¼ miles, was kept with a margin of 10 sec. in hand, the time of 53 min. 35 sec. for the 50¾ miles from Stafford being particularly good. On starting from Rugby the engine slipped badly, so that it took 13 min. 25 sec. to pass Welton. But from there *George the Fifth* did splendidly, running from Welton to Roade in 15 min. 5 sec., and from Roade to Bletchley in 13 min. 25 sec., despite a bad signal check just north of the latter town. From Bletchley to Tring took 17¾ min.; from Tring to Watford 14 min., and from Watford to Sudbury, 9½ miles, 8 min. 50 sec.; we should probably have just kept time then from Rugby but for a string of delays on to Euston. But our net time from Rugby to Euston was not more than 91 min., which did the engine great credit with this load.

Another trip with the same train was also interesting, but the load was rather lighter, totalling 52 axles, or 380 tons, although quite a respectable total at that. The engine was a superheater 4–4–0, whose name and number I omitted to note. Whitmore was passed in the good time of 15½ min., and Stafford, despite a very severe signal check outside, in 28 min. 55 sec. The maximum speed at Norton Bridge was 72·5 miles per hour. Stafford to Rugeley took 11 min. 55 sec.; Rugeley to Tamworth, 13¼ min.; Tamworth to Nuneaton, 12½ min.; and Nuneaton to Rugby, 17 min. 5 sec., the engine having thus gained 40 sec. on schedule despite the delay, and a further check outside Rugby. The net time from Crewe to Rugby on this fine run certainly did not exceed 80½ min. Re-starting from Rugby, we passed Welton in 11 min. 35 sec., but were badly slowed for permanent way works at Weedon. So we took 17 min. 10 sec. from Welton to Roade, passed at 52·9 miles per hour, but did very well again from there, running from Roade to Bletchley in 13 min. and Bletchley to Tring in 17 min. 5 sec., speed not falling below 45·5 miles per hour at Tring summit. From Tring we ran fairly briskly to Euston, taking 14¼ min. to Watford, 11 min. thence to Willesden (maximum at Sudbury 72·5 miles per hour), and 6 min. 55 sec. from Willesden into Euston. Our gross time from Rugby was thus 91 min. and our net time 88½ min., so that the engine on this journey again had gained 7 min. in all from Crewe to London.



NEW 2–6–2 SUBURBAN AND BRANCH TANK ENGINE: GREAT WESTERN RAILWAY.

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A recent run on the Birmingham service also deserves mention. No. 2177, *Malta*, had on this trip a load of 42 axles, weighing empty 299 tons, and with passengers and luggage—the 5 p.m. *ex*-Birmingham is always a very full train—315 tons. The start was wonderful, Marston Green, 6¼ miles, being passed in 8 min. 35 sec.; Berkswell, 13 miles, in 14½ min.; Coventry, 19 miles, in 19 min. 20 sec.; Brandon, 24 miles, in 23 min. 15 sec., and the 83¼ mile-post, just outside Rugby and 29¾ miles from the start, in 28 min. 35 sec. At Marston Green we were doing 70·3 miles per hour, and at Hampton 72·5; at Tile Hill the rate had fallen to 61·6 miles per hour, but beyond Coventry we sustained for a considerable distance a speed of 76·3 miles per hour. Rugby station was passed very slowly in 30 min. 40 sec. from the start. After this the running was easier; at Kilsby we had accelerated against the grade to 51·1 miles per hour, and we passed Welton in 9 min. 10 sec. from Rugby. The 5¾ miles from Welton to Weedon took 5 min., and the 6¾ miles thence to Blisworth stop—for unfortunately I was travelling in the Northampton slip-coach—6¾ min. Our total time from Birmingham to Blisworth, therefore, was 50 min. 35 sec., against a booking of 54 min. for the 50¼ miles, the engine having thus gained nearly 3½ min. even on a crack booking of this character.

From Blisworth I proceeded on another day by the 4.41 p.m. express to London, the train being a light one of 6 eight-wheelers, including tea-car, or 180 tons in all, and the engine a non-superheater "Precursor." Of course, the running with this light train required no effort, and 6 min., all but 5 sec., were gained to Willesden, although the present booking allows time for a conditional stop at Watford. From Blisworth to Roade the 3 miles took 5½ min.; thence we covered the 13⅛ miles to Bletchley in 13 min. 20 sec.; the 15 miles from Bletchley to Tring in 16 min.; and the 14⅛ miles from Tring to Watford in 13½ min. The last 12 miles from Watford to the stop at Willesden were covered briskly in 11¾ min., making our total time for the 57½ miles from Blisworth to Willesden 60 min. 5 sec.—a smart, though not remarkable performance.

I should like to have described in detail the large number of London and North Western runs that I have received from correspondents, but considerations of space, make this impossible. In order, however, to call attention to the most noteworthy of them, I have tabulated five of the best down runs herewith. These, by the way, were received from four different correspondents, and bear still further tribute to the way in which the modern London and North Western locomotive stock—and especially the 4–4–0 engines—handle enormous loads. The three runs on the 5.30 p.m. down, with its fast booking to Rugby, are particularly fine. I could mention many others of which friends have sent on details. No. 2197, *Planet*, a superheater 4–4–0, ran from Stafford to Rugby, 50¾ miles, in 53 min. 35 sec., start-to-stop, and followed this up by covering the 77¼ miles to Willesden in 79 min. 40 sec., representing gains respectively of 4½ and 3¼ min. on schedule time. The times on the second stretch were: Rugby to Welton, 10 min. 55 sec.; Welton to Roade, 14 min. 55 sec.; Roade to Bletchley, 12 min. 5 sec.; Bletchley to Tring, 16 min. 10 sec.; and Tring to Willesden, 25 min. 35 sec. And this, be it said, was achieved with a load of 390 tons! No. 981, *Sir W. S. Gilbert*, 4–6–0, took the Irish boat express from Stafford to Chester, 45¾ miles, in 56 min., inclusive of the usual bad slack at Crewe, gaining 2 min. on schedule—this with a load of 40 axles, or 290 tons. Proceeding with an increased load of 52 axles, or 380 tons, Rhyl, 30 miles, was passed in 33 min. 10 sec.; Llandudno Junction, 44⅝ miles, in 47 min. 27 sec.; and Bangor, 59¾ miles, was reached in 65 min. 32 sec. from the start—2½ min. under schedule. The last stage of 24¾ miles from Bangor to Holyhead was covered in 31 min. 50 sec., or 2 min. 10 sec. under booked time, so that the engine had gained in all over 6½ min.

These are but random examples from the daily practice of the London and North Western Railway. It may be argued that the coal consumption required by these feats is very heavy—the table of locomotive costs given in the November issue, by the way, does not confirm this supposition—but even if it were, the saving in working expenses occasioned by the ability of the engines to work these vast trains to time must more than outweigh the increased cost of coal. That is to say, it is a question of the return in profits obtained from each ton of coal consumed. Beyond this, however, it is a sheer delight to the observer to chronicle runs on the London and North Western Railway. Drivers would appear to make it almost a point of honour to regain and more than regain all lost time, save only

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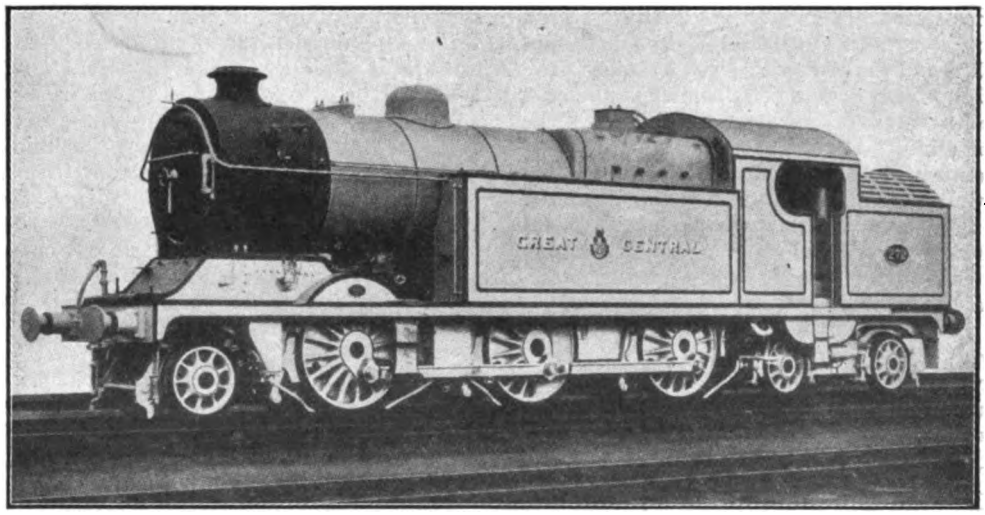
when chronic delays from troop specials render this out of the question. So far as my own recent experience goes, indeed, it seems almost impossible to travel on the North Western without a substantial gain accruing to the locomotive at the close of the run. This, both from the public and the railway standpoint, is an excellent state of affairs, reflecting the greatest credit both on the locomotive administration at Crewe and on the drivers and firemen. But it is fitting that the "Premier Line" should be thus in a position to claim the premier position also in the matter of locomotive performance.

2-6-4 TANK ENGINE: GREAT CENTRAL RAILWAY.

Designed by Mr. J. G. Robinson, Chief Mechanical Engineer.



Some time ago a line diagram and particulars were given of a new 2-6-4 tank engine designed by Mr. J. G. Robinson for the Great Central Railway, and intended more particularly for goods and mineral traffic under conditions where the convenience of a tank engine is desirable, though considerable water and coal capacity is included in the design. This new class is also interesting as initiating the 2-6-4 type in British practice, this wheel arrangement being found only, hitherto, on certain narrow-gauge railways in Ireland.

The first of these has now been completed at Gorton Works, and is illustrated above. It is fitted with Robinson superheater and usual fittings.

Leading dimensions are :—

Cylinders—Diameter	.. ..	21 in.
,, Stroke	.. ..	26 in.
Pony truck wheels, diameter	..	3 ft. 0 in.
Coupled wheels	,, ..	5 ft. 1 in.
Bogie wheels	,, ..	3 ft. 0 in.
Boiler—Diameter	.. ..	5 ft. 3 in.
,, Length outside	..	12 ft. 3 in.
Firebox ,,	.. ..	8 ft. 6 in.
Heating surface—		
Tubes, outside	.. ..	1,385 sq. ft.
Firebox ,,	.. ..	157 ,,
Superheater, inside	..	304 ,,
Total	.. ..	1,847 sq. ft.
Grate area	.. .. ..	26 ,,
Coal capacity	.. .. ..	5 tons.
Water	.. .. ..	3,000 galls.
Weight in working order		.. 96 tons 8 cwt.

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Locomotive and Train Working in the latter part of the 19th Century.

LONDON AND NORTH WESTERN RAILWAY. [No. II.]

By E. L. AHRONS, M.I.Mech.E, M.Inst.Loco.Eng.

THERE were three classes of passenger tank engines in the London district during the late 'seventies. The oldest were the 0–4–2 well tanks built at Wolverton, a few of which also acted as station pilots at Euston. I remember seeing 1811 and 1822 daily in this capacity; they had the old McConnell domes. The most numerous class were the 4–4–0 Metropolitan tanks Nos. 2055 to 2070, which worked from Willesden and Chalk Farm over the North London, and also over the District Railway. They were occasionally used for banking the expresses from Euston to Chalk Farm; for in those days every main line express had a banking engine at the rear. This "banker" remained in a siding and as soon as the express had entered the tunnel, the points were put over and the assisting engine ran after the express. This method of working required skilful handling of the bank engine, and would not now be allowed. Generally, however, six-coupled "special tanks," such as Nos. 2040 and 2041, were used.

To return to the Metropolitan engines, I once saw a small drawing published in which these engines were shown with Ramsbottom's ornamental chimney caps. As a matter of fact they never possessed these, but always had Mr. Beyer's copper tops. Why Mr. Beyer was allowed a special license for his copper-topped chimneys on nearly all railways, when other people had to put on such chimneys as they were told to do, remains one of those railway conundrums that has never been solved. But it must be admitted that they always looked well, generally a great deal neater than the chimneys which replaced them.

Lastly, at the end of 1877 or beginning of 1878, there appeared on the Watford and St. Albans trains a number of Mr. Webb's 2–4–0 radial tanks, Nos. 2282 to 2288, with 4 ft. 7 in. wheels and 17 in. by 20 in. cylinders. These replaced the old Trevithick "singles."

I have now reviewed the London-Rugby-Crewe sections insofar as the "Bloomers" and "Precedents" worked over this part of the line, and now I ask my readers to imagine themselves transferred to Stafford. Once the gateway on the main line to the northern division, Stafford was then a locomotive station of the first importance; though now its glory has utterly departed. The main line "greyhounds" have all gone —all that remain are a few branch line tank engines.

A somewhat noteworthy feature of the locomotive working in 1876 to 1880 was that the Manchester and Liverpool expresses usually changed engines at Rugby, the Scotch expresses at Crewe, and the Irish Mails and expresses at Stafford. The cause may perhaps be traced back to 1860, when the Trent Valley line from Stafford to Rugby became part of the Southern Division under the Wolverton locomotive department, so that Stafford became the point where the trains were handed over to the Northern Division.

Stafford was in a sense the home of the "Lady of the Lake" class. There were about 15 of these engines stationed there, divided into two links, of which the No. 1 link ran the Irish Mails, both north and south of Stafford, and the other link ran express and fast trains to Birmingham, Rugby, Crewe, etc.

No. 675, *Ivanhoe*, of this celebrated class, is illustrated on page 138. In 1876 all these engines had the Ramsbottom splashers with oval apertures, and looked better than they did later when the splashers were closed, an alteration which took effect between 1879 and 1883. The cylinders were 16 in. by 24 in., the driving wheels 7 ft. 7½ in. dia., leading and trailing wheels 3 ft. 9 in. dia. The wheelbase was comparatively short, only 15 ft. 5 in., and this, combined with the outside position of the cylinders, produced a "boxing" or unsteady swaying motion at high speeds. This was particularly noticeable to an observer on a wayside platform. The total

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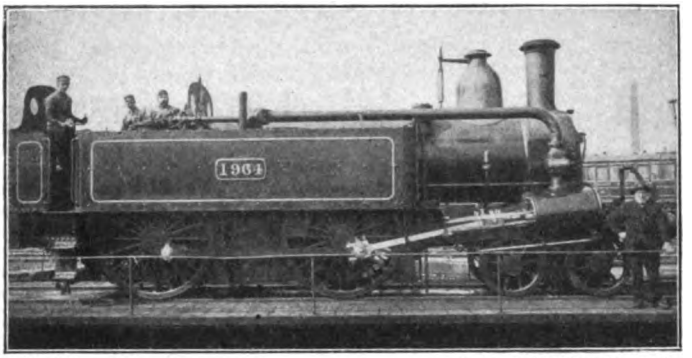

Photo] [*Loco Publishing Co., Ltd.*

NO. 1964 (FORMERLY 2055 CLASS) METROPOLITAN TYPE TANK ENGINE USED FOR BROAD STREET–MANSION HOUSE SERVICE.

These engines had Beyer, Peacock's copper top chimneys for the first ten years.

heating surface was 1,098 sq. ft. and the weight in working order only 27 tons, of which 11½ tons rested on the driving wheels. These engines underwent two rebuilds, the first of which merely consisted of a new boiler and the closing of the splashers mentioned above. Between 1895 and 1897 they were again rebuilt with larger fireboxes, and the weight was increased to about 29¼ tons. The new tyres were thicker than the old ones and increased the size of the driving wheels to 7 ft. 9 in.

A complete list of these engines, when built, and where they were stationed in 1878–1880, is as follows :—

"LADY OF THE LAKE" CLASS, 1878–1880.

		Date built.	Shed No.
1	*Saracen*	1861	14
7	*Scorpion*	1861	14
28	*Prometheus* ..	1861	16
33	*Erebus*	1860	15
44	*Harlequin*	1860	14
60	*Tantalus*	1860	16
61	*Phosphorus* ..	1860	—
77	*Mersey*	1860	15
97	*Atalanta*	1860	14
111	*Russell*	1860	14 later 16
117	*Tiger*	1860	—
127	*Peel*	1862	16
134	*Owl*	1860	—
139	*Cygnet*	1861	—
165	*Star*	1860	29 later 10
184	*Problem*	1859	15
196	*Leander*	1860	16
218	*Wellington* ..	1862	—
222	*Lily*	1860	14
229	*Watt*	1859	26
230	*Monarch*	1860	15
234	*Mazeppa*	1861	14
279	*Stephenson*	1862	—
291	*Prince of Wales* ..	1862	—
531	*Lady of the Lake* ..	1862	15
561	*Prince Oscar*	1861	15
562	*Palmerston*	1861	26
563	*Combermere*	1861	—
564	*Majestic* ..	1861	16
565	*Napoleon* ..	1861	16
610	*Princess Royal*	1863	—
612	*Princess Alice*	1863	14 later 15
618	*Princess Alexandra*	1863	26
622	*Prince Alfred*	1863	16
665	*Lord of the Isles*	1863	—
667	*Marmion* ..	1863	16
675	*Ivanhoe* ..	1863	—
719	*Outram* ..	1863	—
723	*Clive* ..	1863	15
754	*Ethelred* ..	1862	14
762	*Locke* ..	1862	15
802	*Red Gauntlet*	1863	16
803	*Tornado*	1862	15
804	*Soult*	1862	—
806	*Waverley*	1863	—
818	*Havelock*	1863	26
827	*Victoria*	1862	14
833	*Clyde*	1863	15
834	*Elgin*	1863	—
837	*Faeric Queen*	1862	15
1427	*Edith*	1865	15
1428	*Eleanor*	1865	—
1429	*Alfred Paget*	1865	15
1430	*Pandora*	1865	15
1431	*Psyche*	1865	15
1432	*Panopea*	1865	15
1433	*Daphne*	1865	14
1434	*Eunomia*	1865	16
1435	*Fortuna*	1865	14
1436	*Egeria*	1865	14

14 Stafford 16 Manchester 29 Carlisle
15 Crewe 26 Liverpool 10 Birmingham

The Stafford No. 1 link had two turns to London. With the first of these they left Stafford with the up Irish Mail at 3.23 a.m., due at Euston 6.45 a.m., and came down with a train at 9.15 a.m. to Rugby. They reached Stafford at 2.58 p.m.—rather a long day's work. The second turn was the 3.8 p.m., due at Euston 6.25 p.m., and they returned with the down Irish Mail at 8.25 p.m., due at Stafford 11.40 p.m. Here another Stafford engine of the same class took the train through to Holyhead (due 3.5 a.m.). On this turn they returned with the up day express from Holyhead and reached Stafford at 3.5 p.m. The down day Irish Mail (7.15 a.m. from Euston) left Stafford at 10 a.m. for Holyhead and the engine returned with the night mail due at Stafford 3.20 a.m. They also worked a train to Chester and back. From the above it will be seen that the whole of the Irish Mails—except the 7.15 a.m. from Euston to Stafford—were in the hands of the Stafford "Ladies"

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from end to end. They could not work the down 7.15 a.m., as they reached Euston on the up train at 6.45 a.m., and had not time to turn and get ready.

But I regret to say that the Irish Mails of those days were trains that jogged along in the consciousness of a reputation only, without deeds in the way of speed to suit. Their real speeds were poor, and their running average (exclusive of stops) was only 42 miles per hour. Yet they were sometimes referred to as the "Wild Irishmen"!

At the end of 1881 or beginning of 1882, Crewe "Precedents" ousted the Stafford "Ladies" from the Irish Mails between Crewe and London, and, as previously mentioned, the up train was handed over to the first of Mr. Webb's compounds.

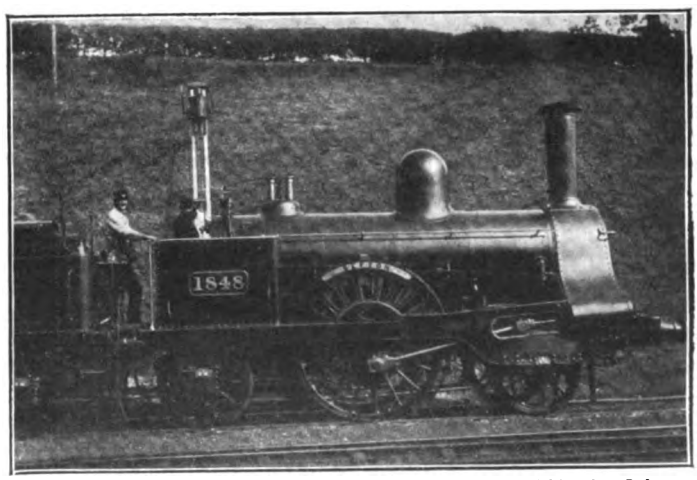
The best main line train worked by the "Ladies" was undoubtedly the 4 p.m. from Euston to Manchester. 667 *Marmion* on one occasion ran from Willesden to Rugby in 95½ minutes, and 127 *Peel* on another day in 95 minutes, the last averaging nearly 49 miles per hour. But even then the 7 ft. "Bloomer" *Baronet* took only 93¾ min. on the same train.

Of the 60 engines of the "Lady of the Lake" class, some 15 were at Stafford, and about 15 to 20 at Crewe. The two sections of the London and North Western Railway over which many expresses were headed by these engines were those between Crewe and Manchester (London Road) and Manchester (Victoria) and Liverpool.

As it is perhaps more convenient to deal with the class as a whole, let us leave Crewe for the time and travel to Manchester. At the latter place engines were stabled at Longsight and also at Ordsall Lane, the latter for the trains to Liverpool, Chester, Preston, etc. In those days both sheds were No. 16, but late in the "'eighties" Ordsall Lane was entirely separated from Longsight as a distinct locomotive depôt. There were engines of this class at both sheds, of which seven or eight were at Longsight and worked to Crewe and to London, and some half-a-dozen at Ordsall Lane for the 45 min. (previously 50 min.) Liverpool expresses.

On the Crewe and Manchester road I timed them on several occasions between 1885 and 1890, but there was never anything remarkable in the way of speed to be chronicled. My best run was with *Lady of the Lake*, 531, Crewe to Stockport, 25¼ miles in 30 min. 10 sec. with 9½ coaches, about 120 to 125 tons, average speed 50¼ miles per hour. An almost identical run with No. 1 *Saracen* took 5 seconds longer, and in the opposite direction No. 230 *Monarch*, on the 4.15 p.m. express from Manchester, ran from Stockport to Crewe in 34 min. 30 sec. with seven coaches the booked time being 35 minutes. On this run the speed was "jerky," but from the 167th post to the 160th post the seven miles were covered in 7 min. 1 sec. The highest speed I ever registered with these engines was only 64½ miles per hour, but there is not the slightest doubt but that they could run a good deal faster.

In 1880 the fastest booked runs of the London and North Western Railway were on the Manchester and Liverpool section, the best timing being from Ordsall Lane to Edge Hill, 29⅛ miles in 34 minutes—speed 51·4 miles per hour. There was also a run from Manchester to Rainhill at 50·3 miles per hour, and Edge Hill to Patricroft at 50·2 miles per hour. The hourly expresses upon which the London and North Western Railway prided themselves did not call for much in the way of speed. All these



Photo] [*Loco. Publishing Co., Ltd*

TREVITHICK 6 FT. SINGLE, NO. 1848 (FORMERLY 925) *Sefton*, AS REBUILT.

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trains were extremely light and usually consisted of four or five six-wheeled coaches only.

At one period there was an isolated "Lady" stabled at Carlisle—generally No. 165 *Star*. I suppose she was employed for piloting trains to Shap, as for any other work she would have been useless over the Westmoreland hills. I never saw one of the class on the Leeds section until 1898, when No. 1 *Saracen* was quartered at Leeds to run a through London and North Western Railway Scarborough express over the North Eastern Railway from Leeds to York. I used to see her going through Church Fenton with about 8 coaches in fine style, with the characteristic lateral wobble very pronounced. But about 18 months later when I travelled on this train, *Saracen* had disappeared, and a "Precedent" was in her place.

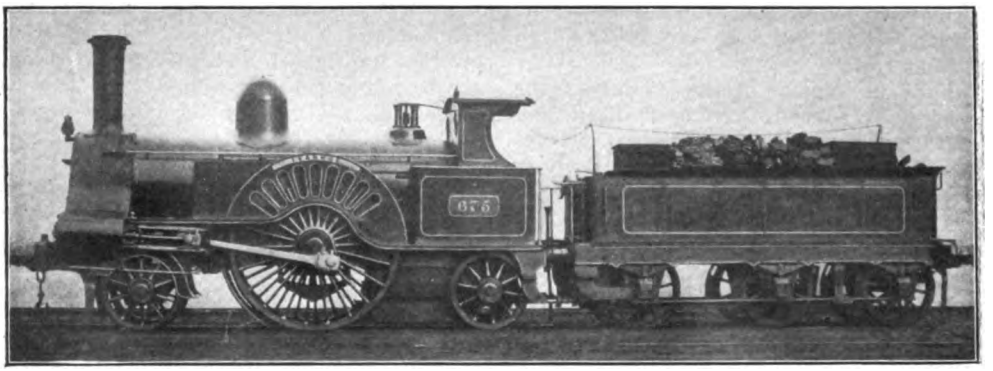
When Crewe found that more of the "Ladies" were stationed there than they

14th, 1888, and may be of interest :—

				Speed.
—	Euston	..	dep. 10. 0	—
5½	Willesden	..	pass 10.10	52½*
30	Post 30	..	,, 10.38	
31½	Tring ..	..	,, 10.39½	60
46½	Bletchley	..	,, 10.54½	
63	Blisworth	..	,, 11.11½	58½
82½	Rugby	..	,, 11.34	52†
97	Nuneaton	..	,, 11.50	54½
110	Tamworth	..	,, 12. 1½	67·8
118	Lichfield	..	,, 12. 8½	68·6
133½	Stafford	..	,, 12.28½	43½‡
150	Madeley	..	,, 12.48	50¾
158	Crewe	..	arr. 12.58	48

* P.W. slack near Boxmoor.
† Signal check approaching Rugby.
‡ Speed reduced through Stafford.

The downhill speed from Nuneaton was very good, and though the uphill portion to Tring was also good, that from Lichfield to Stafford was poor. The running average throughout was 53¼ miles per hour. Now this is only just the speed at which the Great Western Railway "Flying Dutchman" of those days was timed from Paddington to Swindon, but then the "Dutchman" very rarely kept time on the down journey, though it frequently did so on the downhill run from Swindon to London. And the Great Northern were at the same period running their Manchester expresses daily at 54 miles per hour between King's Cross and Grantham !



NO. 675 *Ivanhoe*, AS RUNNING 1878-1882, AND FITTED WITH CAB.

required, some half-a-dozen were handed over to Chester shed and were frequently to be seen on the Chester-Manchester service.

Just when it seemed as if their day was over, the 1888 "Race to Scotland" developed. For a short time Webb's compounds were used, but when the speed was increased, and the load lightened, two of the old "singles," Nos. 667 *Marmion* and 806 *Waverley*, were requisitioned for the run with the 10 a.m. from Euston to Crewe. This was in all probability the fastest running they ever did. The following log of a run by 806 *Waverley* and four coaches weighing 80 tons is condensed from *The Engineer* of September

I give the details of the run, as it was probably the best performance of a "Lady of the Lake," but although a great deal was made of it at the time, it can be considered only as a very good but not a phenomenal performance.

The last days of the class were somewhat

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depressing. One or two ran between Shrewsbury and Welshpool, several piloted at Holyhead, and I saw 139 *Cygnet* at Addison Road with a train of horse boxes just prior to its disappearance, while others worked between Euston and Bletchley on light secondary trains and on the branches. After Mr. Webb's departure, his successor scrapped all of them, between the end of 1903 and the end of 1907, after 40 to 45 years' work.

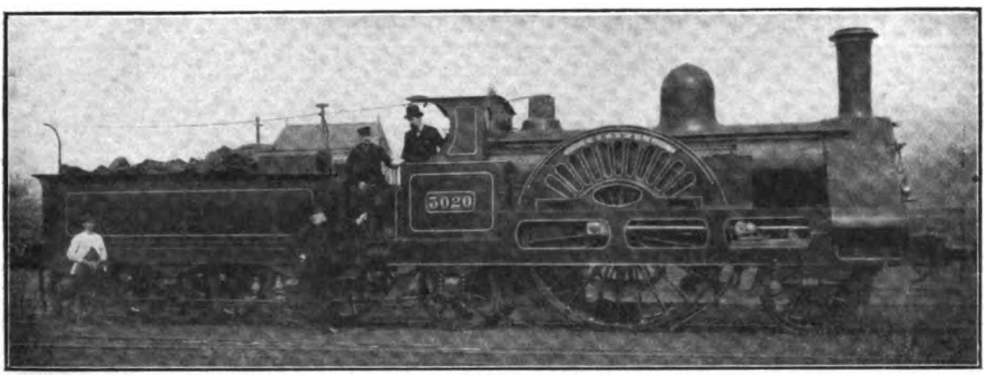
Had I been dealing with the locomotives chronologically instead of "geographically," the Trevithick "singles" would have had to have taken precedence of all those previously described. But the Trevithicks belonged so essentially to the Northern Division that they could not very well be described when dealing with the London end of the line. The few that drifted into the Southern Division never appeared "at home" there, and retired to the north again.

The most famous of all was the celebrated 8 ft. 6 in. single *Cornwall*, No. 173. Though built in 1847, its present style dates from 1858, and I believe I am correct in stating that the late Mr. Webb, then in the drawing office at Crewe, made the drawings from which the 1858 alterations were carried out. At one time, long prior to the period of which I am writing, the *Cornwall* was engaged in working the Scotch Limited Mail between Crewe and Carlisle. How the 8 ft. 6 in. wheels behaved on the Shap bank is not stated—more's the pity!

In 1877 *Cornwall* was doing duty between Chester and Shrewsbury *viâ* Whitchurch. I fancy the engine must then have been stabled at Crewe; at all events she was there in 1880. For traffic purposes it was classed with the "Lady of the Lake" engines, and early in the "'eighties" was transferred to Liverpool to run the 45 minute Manchester expresses (subsequently accelerated to 40 minutes). It remained on this work for a good many years. My last journey behind it was on a semi-fast train from Manchester to Chester, the speed of which was such as not to be worth timing, and I very much regret that I have no sample of *Cornwall's* performances to lay before readers. I saw it frequently, and its trains always, within my recollection, kept excellent time between Liverpool and Manchester. After lying in Crewe works for some years, it is now Mr. Bowen Cooke's inspection engine.

The *Cornwall* was, however, only an isolated specimen. Of the other Trevithick singles there were a good many examples at work between 1876 and about 1885. The large class with 7 ft. wheels consisted of 17 engines, which for four or five years had been the Northern Division express engines until the "Lady of the Lake" class appeared. But their day was very short, and long since over, for even prior to 1876 they had been relegated to the slowest of slow trains.

Originally they had the old Crewe type of safety valves, fixed both on the firebox and on the centre of the boiler barrel, and were without domes. Mr. Ramsbottom rebuilt one or two of them with domed boilers and "Ramsbottom" safety valves. The cylinders, originally 15¼ in. dia., were mostly 16 in. dia. by 20 in. stroke. With the exception of one or two at Stafford, nearly all these engines were stationed at Manchester or Liverpool. The earliest engine of the class



Photo] [*Loco. Publishing Co., Ltd.*

Cornwall, NO. 3020 (FORMERLY 173) AS REBUILT.

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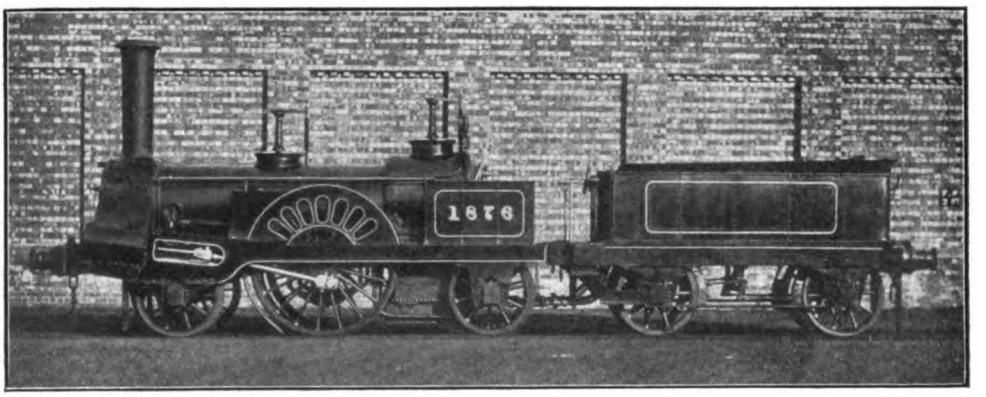
was No. 187 *Velocipede*, built at Crewe in 1847, but all the others came out between 1854 and 1857. In 1877 they were renumbered in the "scrap list" above 1800, and were mostly condemned in 1878 to 1880. The following is the list of these engines:—

	Renumbered.	
12 ..	1806 ..	*Centaur*
18 ..	1829 ..	*Cerberus*
20 ..	— ..	*Eagle*
31 ..	1840 ..	*Pegasus*
40 ..	1852 ..	*Jason*
144 ..	1899 ..	*Raven*
151 ..	1918 ..	*Goldfinch*
187 ..	1932 ..	*Velocipede*
223 ..	— ..	*Rose*
290 ..	1810 ..	*Rocket*
340 ..	1941 ..	*Euston*
341 ..	1897 ..	*Miranda*
342 ..	— ..	*Amphion*
344 ..	— ..	*Kestrel*
920 ..	— ..	*Etna*
923 ..	1835 ..	*Chandos*
924 ..	1880 ..	*Marathon*

To tell the truth they were never really Lichfield. Several were at Manchester, but the greater number collected at that "home for lost dogs," Warrington (23) shed, the foreman of which must have had the care of most of the Northern Division "crocks" at one time or another. The list of these 6 ft. Trevithicks at work at this time is as follows:

6 FT. OUTSIDE CYLINDER "SINGLES," TREVITHICK TYPE.

		Renumbered.	Shed No.
42	*Sunbeam*	1856	15
110	*Canning*	1857	6
137	*Crane*	1853	—
148	*Penguin*	1853	1, 23
150	*Linnet*	1857	3, 23
169	*Huskisson*	1857	10
178	*Friar*	1857	—
179	*Nun*	1857	—
193	*Pearl*	1857	—
195	*Emerald*	1857	16
217	*Emperor*	1857	23
259	*Windermere* ..	1857	16, 23
311	*Ida*	1858	1, 23



TREVITHICK 6 FT. SINGLE, WITH 15 IN. BY 20 IN. CYLINDERS.

powerful enough; the *Velocipede* of 1847 was a large engine for her day, but the engines of 1854 to 1857, with a tractive force of only 55⅓ lbs. and a weight of 9 tons 12 cwt. on the driving wheels, were even then anachronisms. Hence they lasted only 20 to 22 years. The very similar engines with 6 ft. driving wheels were, however, longer lived—probably they were, though very light, much more useful engines. The cylinders were mostly 15 in. by 20 in., but Mr. Ramsbottom had rebuilt several with his boilers and 16 in. by 20 in. cylinders. Some of these engines were to be found in the Southern Division. No. 110 *Canning* was at Peterborough for a considerable time. Birmingham had a few, which at one time were to be seen on the Derby service *vid*

313	*Prince Ernest* ..	1857	16
315	*Prince Arthur* ..	1853	—
321	*Autocrat*	1858	16
323	*Greyhound*	1853	—
324	*Messenger*	1853	1, 23
333	*Hardinge*	1857(?)	15, 23
353	*St. Arnaud* ..	—	1, 23
363	*Empress*	1855	23
365	*Vesta*	1855	1, 23
366	*Nestor*	1855	—
367	*Nightingale*	1855	16
373	*Snake*	1858	23
489	*Alchymist*	1855	23
490	*Ambassador* ..	1855	—
491	*Blenheim*	1853	16
492	*Trevithick*	?	10
495	*Trafalgar*	1855	23
496	*Quicksilver*	?	—
925	*Sefton*	1857	—
926	*Ant*	1855	16
927	*Latona*	1855	10
928	*Prince Eugene* ..	1853	1, 3

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OLD LANCASTER AND CARLISLE ENGINES.

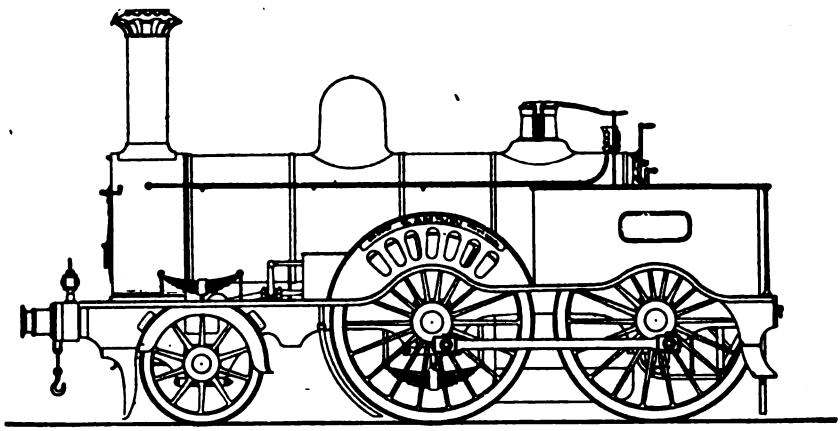
1188 (later 1903)	*Ulleswater* ..	30
1192	*Lazonby*	16
1193	*Wennington*	—
1194	*Duchess of Lancaster* ..	—
1196	*Lang Meg*	—
1191 (1898)	*Ingleboro'* ..	28

1	Camden	15	Crewe
3	Bletchley	16	Manchester
6	Northampton and Peterborough	23	Warrington
		28	Tebay
10	Birmingham	30	Shrewsbury

Many of their numbers were afterwards taken by Mr. Webb's "Experiment" compounds, and most of them were broken up between 1883 and 1885. Several were utilized for many years later as the "Engineer's" inspection engines in various districts.

All the engines in the list were built at Crewe except the last five (Lancaster and Carlisle) engines, which were by W. Fairbairn & Sons, Manchester, and Rothwell & Co., Bolton, in 1857–9, and were slightly larger than the Crewe-built engines. Of these, 1188 *Ulleswater* spent some time on the Shrewsbury and Hereford line, but *Ingleboro'* always worked the Tebay and Ingleton branch, on which I travelled behind it in 1884 just before it was scrapped.

The rivals of the "Trevithicks," as slow train engines, were the 6 ft. coupled Ramsbottom's, the "Samson" class, which were probably the most effete passenger engines of the type that have been constructed for a main line. These engines haunted the byeways of the North Midlands and of Lancashire, though a few were to be found at Bletchley and Northampton. Technically their characteristics were the very small cylinders 16 in. dia. by 20 in. stroke, 6 ft. coupled wheels and 120 lbs. pressure. Physically their chief features were a very small boiler, "about the size of a tea-urn," and a very long chimney, which, when the load exceeded three coaches or thereabouts, emitted a violent shower of cinders and sparks over the surrounding country. The first 50 of them were constructed at Crewe during the years 1863 to 1866, and being such powerful machines, the first one was duly named *Samson!* It is, on the other hand, perhaps fair to say that for the period 1863–6 they were large enough to do the work for which they were designed. But why Mr. Webb built 30 more of them in 1873–4, and followed these by ten further engines of the class in 1879, when they were hopelessly out of date, is one of those things that cannot be explained. The 1879 Webb engines had, however, 140 lbs. pressure. The 1874 and 1879 engines were usually in the Midlands and South. Northampton had several for the Peterborough and Nottingham sections, and the Bletchley branches to Oxford and Cambridge were worked by them after the small "Bloomers" had been scrapped. They also ran the Birmingham and Derby trains for very many years, and Shrewsbury tried to make the best of half-a-dozen of the class. The earlier lot were mostly at Manchester, Warrington, Liverpool, Chester and Preston, but it was noticeable that Crewe never by any chance kept one at their 15 shed; they knew better!



Samson, AS ORIGINALLY CONSTRUCTED BY MR. RAMSBOTTOM IN 1863.

Occasionally, but very rarely, one might be seen struggling over the banks of the Manchester to Leeds road with a very slow train, the speed of which was hardly improved by the efforts of the engine. There is a false

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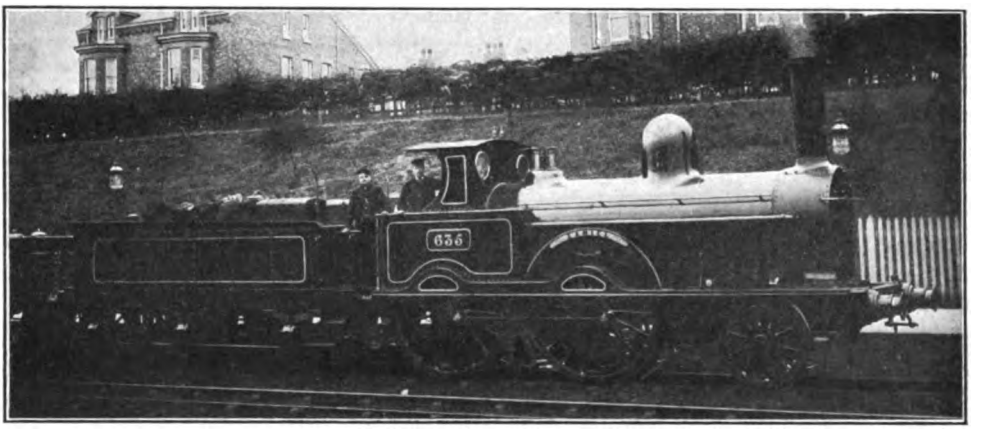

Photo] [*Loco. Publishing Co., Ltd.*

NO. 635 *Zamiel.* RAMSBOTTOM 6 FT. COUPLED ENGINE, AS ALTERED BY MR. WEBB, AND FITTED WITH CLOSED SPLASHERS AND CAB.

idea that these engines were *rebuilt* as larger engines. It may as well be said at once that they were never rebuilt, beyond the first reboilering, after which they remained as before. Mr. Webb—very wisely I consider—scrapped most of them between 1889 and 1894, lock, stock and barrel, except a few which were retained to run the Engineer's saloon coaches in various divisions. One of these I saw at work quite recently at Longsight.

The 90 engines of the "Whitworth" class, which did very good work in recent years, were absolutely new engines. They have longer wheelbase, new frames, new Allan link motion in place of the old Stephenson link motion, cylinders 17 in. by 24 in. instead of the 16 in. by 20 in. cylinders. All that remained of the old engines were the name plates, in retaining which the old dates were left on, and this probably gave rise to the wrong impression of a "rebuilt" engine. They were not rebuilt but renewed, and anyone who knew both the old and the new classes would at once recognise the great differences between them.

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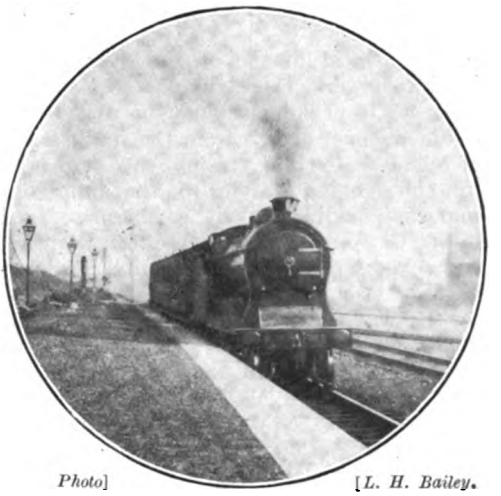
Express Train Facilities on Scottish Railways.

[No. II.].

By J. FRANCIS.



Photo] [L. H. Bailey.

CALEDONIAN RAILWAY.

9.15 a.m. Glasgow-Ardrossan express (for Belfast steamer) passing Muirend. 4-6-0 mixed traffic locomotive No. 917.

ALTHOUGH the Glasgow-Carlisle route of the Glasgow and South Western Railway ranks as its main line, the older Ayr route is actually by far the more important, and by virtue of its steamer, golfing, tourist, suburban and other facilities, carries an enormous volume of traffic. A feature is the semi-fast character of so large a proportion of the trains, due partly to the fact that this company does not attempt to compete very seriously with the comprehensive tramway services in the Glasgow area, while it is also accounted for by the policy of dividing work between trains, so that the majority can be made more or less semi-fast. The timetables of this section are well worthy of careful analysis, but space can only be given for directing attention to the more interesting aspects.

This section may be considered as including two more or less distinct classes of traffic, that to Ayr and beyond and that to Ardrossan, Fairlie and Largs. A Paisley call (either Gilmour Street or Canal, according to the route followed) is usual, but several trains omit this. Consideration of this section is necessary on a summer basis, but first it will be convenient to investigate the winter arrangements.

Taking first the Ayr route, the following trains from St. Enoch may be specially noted:

5.25 a.m. Mondays only. Non-stop (except Paisley) to Newton-on-Ayr, 40¼ miles in 61 min. Thence principal stations to Stranraer.

8.42 a.m. Paisley, Irvine, Newton-on-Ayr, Ayr, Maybole, Girvan and stations to Stranraer.

9.35 a.m. Tuesdays, Thursdays and Saturdays. Paisley, Bogside and stations to Ayr.

11.1 a.m. Saturdays only. Non-stop to Bogside and semi-fast to Ayr and *vid* Turnberry to Girvan.

12.15 p.m. Saturdays only. Non-stop to Bogside and thence stations to Ayr.

12.30 p.m. Paisley and non-stop to Ayr in 60 min., thence Maybole, Girvan and stations to Stranraer.

1.5 p.m. Saturdays only. Non-stop to Troon (35 miles in 52 min.) and stations to Girvan.

2.7 p.m. Saturdays only. Non-stop to Troon and stations to Girvan.

4.10 p.m. Paisley and non-stop to Prestwick. Thence semi-fast to Stranraer.

4.15 p.m. Paisley and non-stop to Irvine and stations to Ayr.

5.10 p.m. Non-stop to Ayr in 55 min., thence to Girvan.

5.15 p.m. Paisley and non-stop to Irvine (other calls on Saturdays) and thence to Ayr.

There are also numerous other trains, such as the 5.55 p.m. non-stop to Kilwinning (26¾ miles), which also merit consideration; in fact, the whole service is virtually of a semi-fast character, only the principal items being noted above. The 5.10 p.m. is the best Ayr down express, and has the longest non-stop

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run, but most of the others involve very creditable work, especially as the loads are often far from light, though the road is not a difficult one, except from the traffic point of view. Certain trains are virtually run for golfing traffic to the numerous courses, including that at Turnberry, served by the Glasgow and South Western Railway, but several others are primarily for long-distance residential traffic. The 9.35 a.m. is, by the way, described by the Company as "The Golfers' Train." In summer the principal additions are the 1 p.m. on Saturday afternoons, which is non-stop in 50 min. to Ayr and thence proceeds *viâ* Turnberry to Girvan; the 1.45 p.m. (Saturdays only) non-stop to Troon; the 4.10 p.m. then becomes a semi-fast all the way to Stranraer to form a daylight service to Ireland; a train at 5.7 p.m. is non-stop to Troon except Paisley, the 5.10 p.m. "flier" getting in advance by proceeding *viâ* Paisley (Canal); and there is a late fast train on Saturdays at 10.15 p.m., non-stop Paisley to Troon, and semi-fast to Girvan.

In the opposite direction the best trains, final non-stop sections only, may be similarly noted:

8.17 a.m. Irvine to Paisley and Glasgow.
8.25 a.m. Ayr to St. Enoch in 50 min. This is the best business train.
8.57 a.m. Irvine to Paisley and Glasgow.
9.13 a.m. Troon to Paisley and Glasgow.
9.42 a.m. Prestwick to Paisley and Glasgow.
1.50 p.m. Ayr to Paisley and Glasgow.
4.58 p.m Bogside to Paisley and Glasgow (Tuesdays, Thursdays and Saturdays).
6.22 p.m. Ayr to Paisley, Eglinton Street and St. Enoch.
7.7 p.m. Bogside to Paisley, Eglinton Street and St. Enoch. (Saturdays only).

The 9.55 p.m. Irish boat service from Stranraer Harbour, with calls at Girvan and Maybole only as far as Ayr (11.30 p.m.), is a decidedly unusual feature of this section. From Ayr it is non-stop to Paisley and St. Enoch, due 12.30 a.m. Several of the trains noted are semi-fast before the final stages mentioned; but this feature need not be gone into.

In the summer schedules the following additions may be noted:

7.3 a.m. Irvine to Paisley and Glasgow (Mondays only).
7.50 a.m. Special Monday express to Paisley and Glasgow.
8.10 a.m. Irvine to Eglinton Street and St. Enoch.
8.4 a.m. Newton-on-Ayr to Eglinton Street and St. Enoch (Mondays only).
8.12 a.m. Barassie to Eglinton Street and St. Enoch.
9.16 a.m. Barassie to St. Enoch.
11.16 a.m. Troon to Paisley and Glasgow
7.53 p.m. Irvine to Paisley and Glasgow (Saturdays only).
8.30 p.m. Ayr to Paisley and Glasgow (Saturdays only).

Dealing similarly with the Ardrossan and Largs route, the winter services give as the most interesting trains from Glasgow the 10.20 a.m., non-stop Paisley to Kilwinning, the 11.35 a.m. (Saturdays only), Paisley to Saltcoats; the 1.10 p.m. (Saturdays only), Paisley to Stevenston; 2.10 p.m. (Saturdays only), Paisley to Saltcoats; 4 p.m., Paisley to Kilwinning; 5.7 p.m. Paisley to Kilwinning; 5.38 p.m. (not Saturdays) St. Enoch to Dalry; and quite a number which run from Paisley to Dalry or call only once or twice intermediately. In the opposite direction may be noted the 8.10, 8.14 and 8.16 (these three times vary as two trains on Mondays and other days) from Kilwinning to Paisley and Glasgow; 8.24 a.m. on Mondays from Ardrossan to Paisley; 8.54 a.m. from Kilwinning; 1.54 p.m. (Saturdays only) Stevenston to Paisley; 4.39 p.m. (Saturdays only) Saltcoats to Paisley; 5.54 p.m. (Saturdays only) Saltcoats to Paisley; and numerous other trains not much inferior.

In summer, however, there are notable additions, and these are sufficiently interesting to be worthy of setting forth in detail From St. Enoch they are:

9.5 a.m. Paisley to Ardrossan (South Beach) and Ardrossan Pier. Arran express.
9.20 a.m. Paisley to Fairlie Pier and Largs. Campbeltown express.
12.24 p.m. Saturdays only. St. Enoch to Saltcoats.
1.10 p.m. Saturdays only. Paisley to Ardrossan (South Beach).
1.15 p.m. Saturdays only. Paisley to Stevenston.
2.0 p.m. Paisley to Saltcoats. Millport express.
3.15 p.m. Saturdays only. Paisley to Ardrossan (South Beach).
4.55 p.m. Paisley to Saltcoats (Saturdays) or Ardrossan (South Beach).

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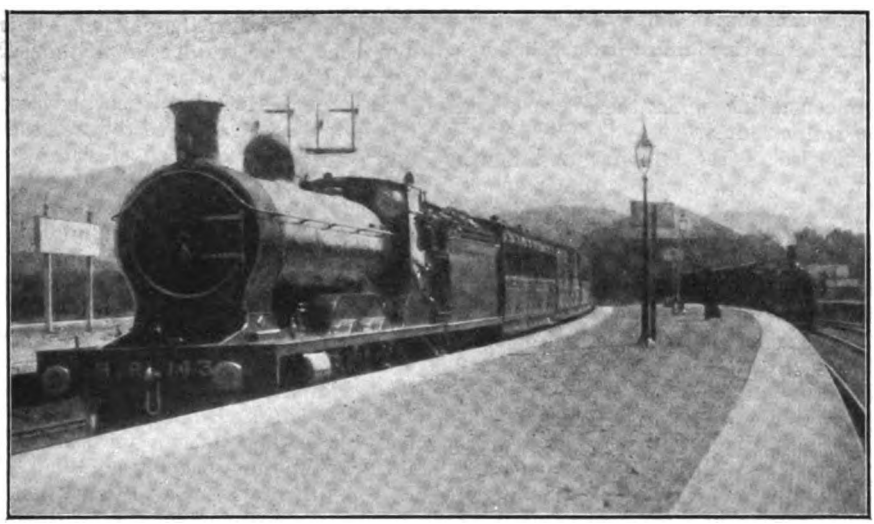
5.20 p.m. Paisley to Ardrossan (South Beach). Millport and Largs express.

Most of the winter trains are included, either as usual or slightly modified, while most other trains are more or less fast to Dalry. In the opposite direction there is an interesting series of special expresses as follows :

5.26 a.m. Mondays only. Saltcoats to Paisley.
6.28 a.m. Mondays only. Stevenston to Paisley.
6.50 a.m Mondays only. Stevenston to Paisley.
7.7 a.m. Mondays only. Saltcoats to Paisley.
7.30 a.m. Largs right through to Eglinton Street on Mondays only.
6.25 p.m. Saturdays only. Ardrossan (South Beach) to Paisley.
6.29 p.m. Not Saturdays. Saltcoats to Paisley.
6.30 p.m. Saturdays only. Saltcoats to Paisley.
6.36 p.m. Saturdays only. Saltcoats to Paisley.
8.42 p.m. Saturdays only. Ardrossan (South Beach) to Paisley.
9.10 p.m. Saturdays only. Saltcoats to Paisley.
9.29 p.m. Saturdays only. Saltcoats to Paisley.

The mere fact that so many of these trains should be run on Mondays or Saturdays only is evidence of the character of the Clyde



Photo] [*Tom M. L. Neish.*

HIGHLAND RAILWAY.

11.50 a.m. Perth-Inverness express at Aviemore. 4–6–0 locomotive No. 143, *Gordon Castle*. The special " Strathpeffer Spa " express is shown to the right.

8.4 a.m. Ardrossan (South Beach) to Eglinton Street.
7.52 a.m. Mondays only. Fairlie Pier to Eglinton Street.
8.23 a.m. Saltcoats to Paisley.
8.22 a.m. Ardrossan Pier to Paisley.
8.45 a.m. Ardrossan (South Beach) to Paisley.
10.12 a.m Saturdays only. Saltcoats to Paisley.
1.54 p.m. Saturdays only. Stevenston to Paisley.
5.53 p.m. Ardrossan (South Beach), with conditional stop at Kilwinning, to Paisley.

coast traffic, especially as a number of the trains are virtually run for specific steamer services *vid* the various piers. It is only when one has seen the crowds of passengers travelling by many of these trains that the volume of this traffic can be realised, especially as many of the trains could be combined were it not that the numbers of passengers travelling during the summer and holiday periods would otherwise call for duplication of trains, a practice which is by no means infrequent as it is. Similar remarks apply also to the Caledonian Clyde coast services previously dealt with. There are also trains from other routes than the main

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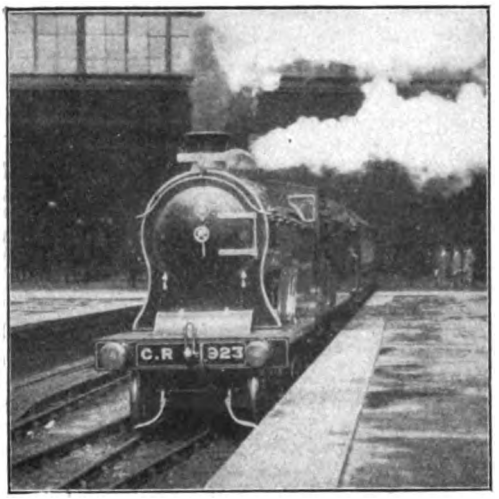

Photo] [*A. Dunsmore.*

CALEDONIAN RAILWAY.

London Express leaving Princes Street, Edinburgh.

lines concentrating upon these coast and steamer traffic routes.

In the case of the Glasgow and South Western route from Glasgow to Greenock, many characteristics similar to those pertaining to the Caledonian Gourock route may be noted; but combined with a degree of residential traffic. Usually these trains travel *viâ* Paisley (Gilmour Street), but the 4.12 p.m. from St. Enoch proceeds *viâ* Paisley (Canal), as also does the 5.12 p.m. in the same direction, and several returning trains. The best winter trains from St. Enoch are the 10.5 a.m. (1 stop, 42 min.); 12.15 (Saturdays only, 4 stops); 1.3 p.m. (Saturdays only, non-stop to Bridge of Weir); 4.3 p.m. (1 stop, 42 min.); 4.45 p.m. (not Saturdays), 4 stops; 5.12 p.m. (5 stops); 5.45 p.m. (not Saturdays, non-stop to Bridge of Weir); and the 7.50 a.m. and 9.15 p.m. Sunday trains. In the opposite direction the 8.3 a.m. from Greenock is non-stop from Bridge of Weir to Eglinton Street; the 8.25 a.m. (42 min.) from Princes Pier to Paisley; the 8.45 a.m. starting from Kilmacolm calls only at Bridge of Weir and Paisley (Canal); the 9 a.m. stops twice and reaches Glasgow in 44 min.; the 10 a.m. (42 min.) is non-stop to Paisley; and the 4.15 p.m. is non-stop Lynedock to Paisley. Other trains are usually more or less semi-fast.

In summer, however, there are notable additions, the following trains making stops as noted: From St. Enoch—8.20 (2), 10.5 (1), a.m., 12.5 (2), 1.3 (Saturdays only, 1), 1.7 (Saturdays only, 3), 1.55 (from Paisley only, on Saturdays, 1), 1.53 (Saturdays only, non-stop), 1.58 (Saturdays only, non-stop), 2.5 (Saturdays only, 4), 2.5 (not Saturdays, 2), 4.3 (1), 4.45 (not Saturdays, 4), 5.5 (not Saturdays, 1), 5.45 (3), 7.35 (2), and 8.45 (Saturdays only, 3) p.m. The virtual duplication of the 1.53 by the 1.58 on Saturdays is another evidence of the volume of this coast traffic. In the opposite direction the best trains are: 6.45 (Mondays only, 2), 8.3 (2), 8.20 (Mondays only, fast Princes Street to Eglinton Street), 8.25 (1), 9 (1), 10 (1), 11.10 (1) a.m., 4.15 (3), 6.10 (3), 7.25 (Saturdays only, 2), and 8.10 (Saturdays only, (3 p.m., with several others more or less fast. Although the average schedules of many of these trains may not appear specially notable, the fact that 42 min. is a standard one-stop schedule for the 25½ miles of steeply graded and difficult road is evidence that the work involved must be of a good character, and that these services really do warrant description as express.

Most of the North British services in the Glasgow area are directed towards the north, and in commencing that section of our subject, it will be convenient to deal with those towards Craigendoran, as analogous to the facilities on other lines just reviewed. As in the case of the Caledonian route to Balloch, the trains run *viâ* the low level lines in Glasgow, both the Caledonian and North British suburban services on these lines being of a very heavy and complicated character. As regards fairly lengthy non-stop runs, owing to calls at Dumbarton and usually at least one other station, most of the "expresses" are not specially notable; but the 3.55 p.m. from Bridgeton Cross (not Saturdays) is interesting as a winter "Boat Express" booked non-stop from Queen Street (Low Level) to Craigendoran Pier in 32 min. (23¼ miles); as also the 4.50 p.m. scheduled in 27 min. from Queen Street to Cardross (19 miles), and the 5.45 p.m. train, fast from Queen Street to Dumbarton in 22 min. (15¼ miles). In the reverse direction the 8.25 a.m. from Helensburgh is non-stop from Craigendoran to Partick, while numerous other trains are more or less fast. The summer time tables show notable additions, but usually one or more stops are included. The 4.50 p.m. from Bridgeton Cross, however, then starts from High Street (previously known as College station) on Saturdays; and of the up trains the 8.23 a.m. from Helensburgh is relieved on Mondays by a special boat express for steamer passengers from Craigendoran Pier

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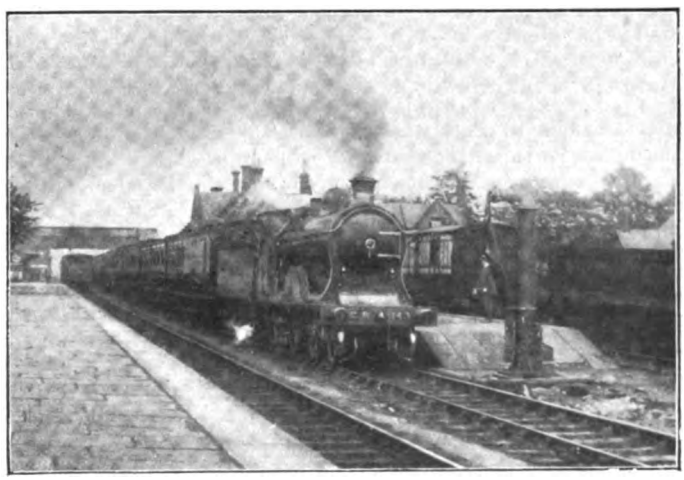
at 8.32 a.m., while the 3.10 p.m. from Craigendoran Pier to Partick introduces a further non-stop run.

In the case of the West Highland section the most interesting winter expresses are the 5.50 a.m. from Queen Street, non-stop, except for a conditional call at Dumbarton, to Arrochar and Tarbet (42¼ miles in 73 min.), and the 7.50 a.m. non-stop from Mallaig to Fort William. Otherwise all trains are slow except between Glasgow stations and Craigendoran. Summer schedules are somewhat elaborate, giving the 4.6 p.m. from Craigendoran to Arrochar and Tarbet, and the 11.16 a.m. and 6.42 p.m. (Saturdays only), from Arrochar and Tarbet to Craigendoran as further non-stop schedules of fair length, though necessarily on this steeply graded single track road, high average speeds cannot obtain.

Although the Caledonian and the North British Railways serve both Glasgow and Edinburgh for northward main line traffic, the one has the strongest position in Glasgow and the other in Edinburgh. Except for cross lines and facilities more or less of a branch character, the Caledonian Company's trains from Edinburgh have to proceed halfway across to Glasgow (they traverse the North British Glasgow main line to near Falkirk) before diverging north, while North British trains have to go nearly across to Edinburgh to reach the Forth Bridge route. This fact largely accounts for the immense advantages each company possesses over the other in regard to the respective divisions of traffic.

In view of the fact that it combines Perth, Aberdeen, Dundee and Highland railway traffic, it will be convenient to deal now with the Caledonian main line to the north from Glasgow. The first train is an interesting one. Leaving the Central station at 4.20 a.m., it is combined at Stirling with the Postal train from England, and with an express connection from Edinburgh, proceeds onwards as the fastest train on the Aberdeen road, calling only at Perth to Aberdeen. Although conveying passengers, its accommodation is limited from Perth to Aberdeen, booked in 97 min. for the 89¾ miles. At its destination it is only 7 min. behind the 8 p.m. from Euston, which proceeds direct from Carlisle to Stirling (a conditional stop) and Perth, and thence calls only at principal stations, some of them conditionally only.

At 7.30 a.m. the first Pullman breakfast and luncheon car train leaves Buchanan Street. As regards the introduction of Pullman cars on these trains, readers may be referred to a special article thereon in the RAILWAY MAGAZINE for July, 1914. This train is also combined with English and Edinburgh portions, and is mainly of a semi-fast character, making a number of important connections. The 8 a.m. from Buchanan Street is a special Callander and Oban express, non-stop to Stirling. The 10 a.m., the first "Grampian Corridor and Pullman Express," calls only at Stirling to Perth (slip carriage detached at Gleneagles) and, combined with the Edinburgh portion, becomes a good semi-fast to Aberdeen, after shedding its Highland vehicles at Perth. At mid-day a special Callander and Oban express leaves Glasgow. The 1.8 p.m. on Saturdays from Buchanan Street is interesting as a fast residential train for Larbert, Stirling, Bridge of Allan and Dunblane, while the 1.25 p.m. is another good train for similar traffic and for Gleneagles (by slip carriage except Saturdays), Crieff and Perth. The 2 p.m. special express from Buchanan Street on Saturdays calls conditionally only at Larbert, being booked non-stop to Perth, with a



Photo] [*L. H. Bailey.*

CALEDONIAN RAILWAY.

Glasgow-Liverpool and Manchester Express starting from Beattock.

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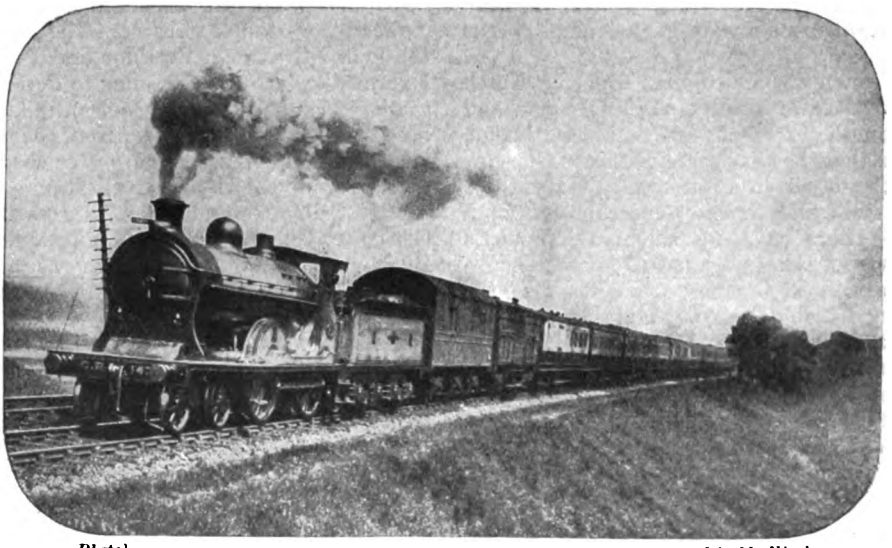
Gleneagles slip, but otherwise calls at Larbert and Stirling, also with a Gleneagles slip. Beyond Perth it is a good semi-fast. On Saturdays it is relieved by the 2.5 p.m. from Buchanan Street for Larbert, Stirling, Bridge of Allan and Dunblane.

At 4.5 p.m. a favourite residential express leaves Buchanan Street for Larbert, Stirling, Greenloaning, Blackford, Gleneagles and Crieff, with a 4.10 fast to Glenboig for nearer stations. Then at 4.45 p.m. is a special Oban express, non-stop to Dunblane in 49 min., and at 5 p.m. a Pullman car "Granite City" express leaves, first stop Larbert, with a portion from Edinburgh at 4.25 p.m. The 6.5 is a good express for Larbert, and principal stations to Perth and Dundee, connecting at Perth with the Aberdeen portion of the 10 a.m. from Euston, which follows to Perth and thence continues to Aberdeen as a semi-fast express, reaching the "Granite City" at 10.15 p.m., an hour behind the 5 p.m. *ex*-Buchanan Street. The 10 p.m. from Glasgow is semi-fast and at Perth is combined with the Aberdeen portion of the 2 p.m. from Euston, arriving in the small hours of the morning.

Several other trains possess local interest, especially in view of the Caledonian Company's cultivation during recent years of residential traffic in the Stirling, Dunblane, Gleneagles and Crieff districts, but need not be reviewed in detail. On Sundays the only through train to Aberdeen is the 7.10 a.m. from Glasgow (Central), combined with the 11.45 p.m. the previous night from London. This service is due at Perth at 8.55 a.m. and is thence semi-fast.

These are the standard arrangements, but in summer, except for the duplication of and additions to the Anglo-Scottish services and other special arrangements, further items of particular interest are the running of the 10 a.m. from Buchanan Street direct to Perth in 86 min., with a relief Callander, Oban, Dundee and Crieff express at 10.10 a.m.; the 1.8 (Saturdays only) "Strathearn" express, non-stop to Stirling; the 2 p.m. is non-stop to Perth, with a relief at 2.5 p.m. to Larbert and beyond, dividing at Stirling to form Callander and Oban and Dundee expresses; and the 4.45 p.m. "Strathearn" (not Saturdays) and Oban express, non-stop to Dunblane.



Photo] [*A. M. Nicol.*

CALEDONIAN RAILWAY.
10.10 a.m. Glasgow-Liverpool Express near Lamington.
4-4-0 locomotive No. 143.

From Aberdeen the 6.40 a.m. (breakfast car train), 10.5 a.m. (Pullman car train), 1.10 p.m. (Pullman car train); 5.30 p.m. ("Grampian" Pullman car train); 5.45 p.m. (Anglo-Scottish train); and the 7.55 p.m. (Anglo-Scottish train), make at least three or four calls to Perth, as also does the 1.10 p.m. on Sundays, so that the 3.40 p.m. Limited Mail train is the only one notable for non-stop working, calling only at Forfar, to Perth.

South of Perth, however, a number of trains become expresses in every sense of the

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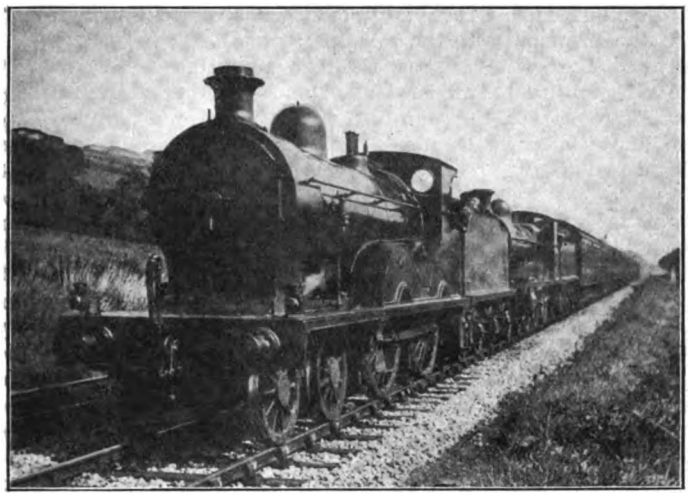

Photo] [*J. Cheyne*

GLASGOW AND SOUTH WESTERN RAILWAY.

11 a.m. Glasgow-London express, near Neilston.

word. The Glasgow portions of the 6.40 and 10.5 a m. trains *ex*-Aberdeen are rather of a semi-fast character; but the corresponding section of the 1.10 p.m. from the "Granite City" (with Pullman cars) stops conditionally at Bridge of Allan and then only at Larbert to put off the Edinburgh portion. In the case of the 3.40 p.m. "Limited" express from Aberdeen this becomes purely a Glasgow train after detachment from the mail portion at Stirling. The 5.30 p.m. "Grampian" Pullman train is, however, non-stop from Perth to Glasgow, and is scheduled moreover to proceed to the Central station instead of Buchanan Street.

In regard to other trains, the 6 and 7.15 a.m. trains from Perth, together with the 8.17 a.m. from Dunblane, become residential expresses into Glasgow, giving reasonably fast journey times and convenient arrivals at Buchanan Street. On Mondays, Wednesdays and Fridays the 7.55 a.m. from Perth connects at Gleneagles with the "Strathearn" express, which, after calling at Dunblane and Bridge of Allan, divides at Stirling, the Glasgow portion (due 9.45 a.m.) calling only at Larbert, while the Edinburgh portion is non-stop to Princes Street (due 9.55 a.m.). The 6 a.m. from Oban (Dunblane 9.7 a.m.) is another fast from Stirling to Glasgow, calling only at Larbert. These trains, together with certain locals, give good facilities for daily residential traffic into Glasgow. On Sundays the Glasgow portion (semi-fast) of the 1.10 p.m. from Aberdeen and the 6 p.m. from Dunblane, both proceed to the Central station.

During the summer months there is an additional residential express from Gleneagles at 7.29 a.m., due at Buchanan Street at 8.57 a.m.; and the 8.49 a.m. from Greenloaning is a further addition. There is also another express from Aberdeen at 10.35 a.m. for Glasgow to relieve the 10.5 a.m., which becomes mainly a West Coast train, while the 1.10 p.m. is relieved by the 12.50 a.m. Pullman express (non-stop except Larbert, Perth to Buchanan Street), and the 5.30 p.m. becomes a purely Glasgow train, with the Edinburgh portion worked by the following train from Perth, the West Coast traffic being taken by the equivalent 5.45 p.m. express from Aberdeen.

While dealing with the Caledonian system it will be convenient to consider remaining items of interest in reference thereto insofar as they call for reference. As regards the Edinburgh-Larbert trains, most of these call at Falkirk (Grahamstown), one or two making a local call in Edinburgh at Dalry Road; but the 4 a.m. from Princes Street is non-stop to Larbert, while the 1.25 p.m. on Saturdays works through to Perth, calling conditionally only at Larbert, and thence only at Stirling, Bridge of Allan, Dunblane and Gleneagles. On other days its working is modified, but still works through to Perth, and the Gleneagles stop is replaced by a slip carriage. The 9.25 a.m. and 4.25 p.m. trains are also through trains to Perth, though stopping rather frequently.

During the summer months there are also the 7 a.m. through train to Callander and Oban, the 1 p.m. Saturday express through to Stirling and stations beyond, with a corresponding "Strathearn" express at 4.50 p.m. on other days. In the opposite direction there is the special "Strathearn" express due at Princes Street at 9.55 a.m., non-stop from Stirling; the Oban train worked separately from Stirling at 10.58 a.m. to Edinburgh; the 10 a.m. from Oban through to Edinburgh; besides other connecting arrangements. In winter the "Strathearn" express, the 9.54 a.m. from Stirling, and the

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3.24 p.m. from Stirling (this runs in advance of the Glasgow portion), are the principal trains worked through north of Larbert. The separate working of the 10.15 p.m. from Perth (off the 7.55 p.m. *ex*-Aberdeen) to Stirling, Larbert, Coatbridge and Glasgow Central is an interesting feature of the working on this section.

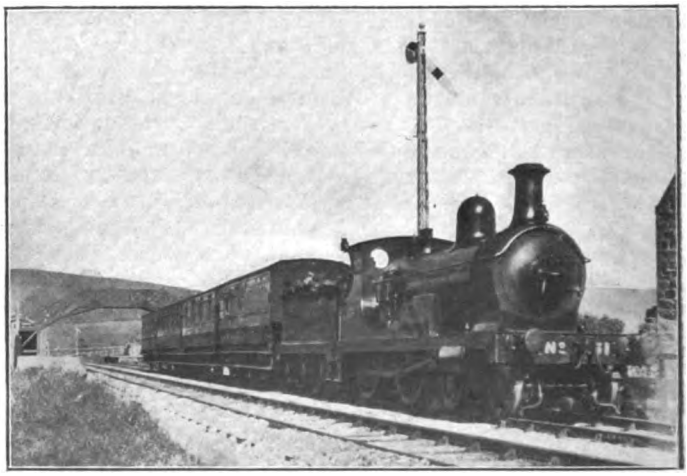
On the Oban route the trains are usually of a stopping character beyond Stirling, though several, especially those for Glasgow residential traffic, are good trains, Callander is the limit of the frequent service portion of this route. In summer the service is, of course, amplified considerably, and certain trains are of a semi-fast character. Similar remarks apply to the Gleneagles and Crieff section.

Between Perth and Dundee there is quite a frequent service of fast trains. The 12.50 a.m., 11.42 a.m., 9.20 a.m. (Sundays) from Perth, and the 3.30 p.m. from Dundee are 30-min. trains (21 miles), the 11.42 a.m. having a conditional stop included; but either non-stop or with one or two regular or conditional stops the 6.10, 9.20 a.m., 3.47, 7.2, 8.10 p.m. and 12.50 a.m. and 4.30 p.m. on Sundays do the journey from Perth in from 32 to 40 min.; while the 8.5, 11.35 a.m., 5 and 7 p.m., and the 8 a.m. and 3.15 p.m. on Sundays similarly take from 31 to 40 min. In summer there are a few additional fast trains on this route of a similar character.

Dealing now with the Aberdeen route of the North British Railway, there are non-stops from Waverley or Haymarket at 3.55 a.m., 10.40 a.m., and 3 p.m., with other good trains, most with restaurant car facilities, but calling at certain important stations, at 7.40 a.m., 6.30 p.m. and 9.22 p.m., besides quite a number of semi-fast trains. No trains are non-stop beyond Dundee, but several restrict the calls made to one or two, with one or more conditional calls, particularly at Arbroath. An interesting feature is that several trains terminate at Montrose, thus avoiding going on to Caledonian territory to reach Aberdeen, while there is quite a series of feeding semi-fasts to the principal trains.

Thus, the 6.23 a.m. collects for the 7.40 a.m. as far as Dundee, that train itself having a semi-fast connection from Ladybank to Dundee; the 9.32 a.m., with a Glasgow connection, collects to Montrose for the 10.40 a.m.; and the 1.50 p.m. similarly serving the 3 p.m. Among trains calling for special remark are the 12 noon semi-fast to Dundee on Saturdays; the combination of the 4.25 p.m. from Waverley and the 4.7 p.m. from Glasgow (Queen Street), run independently as semi-fasts to Dundee and thence continued to Aberdeen; the use of the 5 p.m. slow from Waverley as a pick-up as far as Dundee for the 5.18 p.m. semi-fast from Glasgow, the two trains combining with the 6.30 p.m. from Waverley for continuation to Aberdeen; and the continuation of the 9.22 p.m. from Waverley from Arbroath to Montrose on Saturdays. The independent working of the 8 p.m. from Glasgow to Thornton Junction may be noted. On Sundays there is only the night express from London working through to Aberdeen, remaining trains being two as far as Dundee.

Southwards the 7.38 a.m. from Thornton Junction and the 7.30 a.m. from Dundee to Glasgow may be noted; also the Glasgow portion of the 1.30 p.m. from Aberdeen, worked from Dundee independently, and the 7 p.m. Saturday train from Kirkcaldy to Queen Street, connecting with the 5.35 p.m. from Aberdeen. The only non-stop from Dundee to Edinburgh is the 12.22 p.m.;



Photo] [*W. R. Rainnie.*

GREAT NORTH OF SCOTLAND RAILWAY.

Aberdeen-Grantown excursion train passing Cromdale.

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Photo] [*Tom M. L. Neish.*

HIGHLAND RAILWAY.

12 a.m. Perth-Inverness train at Drumochter Pass Summit (1,484 ft. above sea level).
4-4-0 locomotive No. 60 *Ben Bhreac Mhor.*

but the 8.13 a.m., 3.40 p.m., 5.29 p.m., 7.31 p.m. and 9.32 p.m. are good trains calling only at principal stations. The 10.20 a.m. from Aberdeen is served by the 10.35 a.m. from Montrose, which picks up to Edinburgh therefor; but in the case of the 5.35 p.m. from Aberdeen the train from Montrose follows as a semi-fast to Edinburgh. On Sundays the 3.50 p.m. from Dundee acts as a pick-up to Edinburgh for the 3.30 p.m. Aberdeen-London train.

In regard to the summer facilities may be noted the 9.30 a.m. from Edinburgh and 9 a.m. from Glasgow to Dundee, thence continuing to Aberdeen; the 1.35 p.m. Saturday relief to the 1.50 p.m. from Waverley to Montrose; and certain special expresses operated on specified dates when traffic is very heavy, such is the 7.50 a.m. from Kirkcaldy to Montrose; the 7.30 a.m. from Glasgow to Aberdeen; the special working of the 9 a.m. from Glasgow to Thornton Junction; the 10.37 a.m. from Glasgow to Arbroath; and the 3.43 p.m. from Glasgow to Aberdeen. These are associated with "Glasgow Holiday" and like traffic, but constitute interesting additions to the normal services.

The whole of the train working on this section is of peculiar interest and is well worthy of analysis, but no further space can be devoted thereto on this occasion, except to note some of the branch working associated therewith. From Thornton Junction to St. Andrews is, perhaps, the most important as the Leven and East Fife section, and this is given very good facilities in view of the golfing and other interests of this district. None of the trains are fast on the branch in winter, but the 5.55 a.m. from Anstruther (Mondays only), the 6.7 a.m. from St. Andrews, and the 8.2 a.m. from Leven afford good facilities for reaching Edinburgh and Glasgow in time for business, while the 1.50, 3.50 (to Leven only), and 4.55 p.m. trains from Waverley give corresponding return facilities. By the 8.2 a.m. from Leven, the 8.40 a.m. from St. Andrews, and the 4.5 p.m. from Anstruther, with the 8.50 a.m., 12 noon (Saturdays only), 1.50, 3.50, and 4.55 p.m. trains from Waverley, Leven is brought within about 1½ hours of Edinburgh, with Glasgow trains nearly as good in certain cases. In summer these services are very considerably amplified, Leven being only about an hour from Edinburgh by the 1.30 (Saturdays), and 4.44 p.m. trains from Waverley, and the 8.20 a.m. up; Glasgow is also well served.

Throughout the Edinburgh, Glasgow, Dundee, Stirling, and Perth area the North British Railway operates a complicated series of routes and train services, but most of these are slow or at most semi-fast. The Waverley-Perth route is, however, an exception, as it has all the year round several good trains, and others during the summer. The 4 a.m. from Waverley is the special non-stop Highland express from England, while the 7.45, 10.10 a.m., 2.15 p.m. (Saturdays only), and 6.35 p.m. are other good trains. Returning, the 8.35 a.m., 12.30 p.m., 4.10 p.m., 7.55 p.m. and 9.15 p.m. trains are equally good, though none are non-stop. In summer the down expresses are 3.55 and 4.4 a.m. (non-stop), with the 7.30, 10.5, 2.5 and 6.35 p.m. fast trains; but an interesting feature is the apparent booking of certain "Month-End" reliefs as passing Perth, such as the 9.55 a.m. and the 2.20 p.m. non-stop reliefs. In the case of the up trains the 8.35 a.m., 12.30 p.m., 3.5 ("Month-End") non-stop, 3.50, 4.10, 7.55 and 9.30 (non-stop) p.m. may be noted.

On the Highland Railway, in the ordinary service several trains are semi-fast, notably the 12.50 a.m. from Perth, with sleeping cars from Glasgow to Inverness; the 11.50 a.m. from Perth; the 8.40 a.m. and 11.5

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a.m. from Inverness; with some of the alternative route trains between Inverness and Aviemore *viâ* Forres, and the Inverness-Aberdeen trains. Last month reference was made to the new "Winter Sports" express, constituting a winter variation and improvement of the summer 11.50 a.m. express from Perth and Inverness *viâ* Forres. North of Inverness the 9.50 a.m. down and the 8.40 a.m. from Wick omit a few stations, but are hardly expresses.

During the summer there are, of course, numerous additions, giving the 5, 5.15, 6.15, 11.50 (first booked call at Newtonmore, and travelling *viâ* Forres, serving the Strathpeffer Spa express from Aviemore) a.m., and 3.50 p.m. as express trains from Perth to Inverness; the 8.40 a.m., 2.30, 3.50 and 5 p.m. from Inverness; the "Furthest North" and "Strathpeffer Spa" expresses north of Inverness; and the generally increased and expedited services incidental to the holiday periods.

Great North of Scotland traffic includes a fair proportion of commercial, residential and general traffic, so that the winter schedules are not so strongly differentiated from those operated in summer as in other cases. Thus, the standard Aberdeen-Inverness expresses still apply, leaving Aberdeen at 3.30, 5.50 (Mondays only in winter), 8.5 a.m., 2.20, and 6.45 p.m., with return services from Inverness at 6, 9.8, 11.5 a.m., and 1.10, 3.20 and 6 p.m. These trains are really semi-fast, but they involve good working on several sections. It will be remembered that Highland engines work some of these trains through to and from Aberdeen, a Great North engine correspondingly going through to Inverness, though the balancing work is, in their case, only partially effected on the through trains. Summer services on the Great North main line are more elaborate than in winter, but not to a great degree, while the famous express excursions to Craigellachie and Elgin are, of course, only operated during the holiday periods.

The only other section including fast working in winter is that to Fraserburgh and Peterhead, notably the 8.10 a.m. down, and the 3.40 p.m. up, both semi-fast. Residential traffic between Aberdeen and Dyce and Aberdeen and Culter includes a number of semi-fast facilities. In summer the special Cruden Bay and Deeside expresses are added. The former are semi-fasts, including the 8.10 a.m. from Boddam, Cruden Bay at 8.22 a.m., and reaching Aberdeen at 9.30 a.m., with the 1.30 a.m. on Wednesdays and Saturdays to Cruden Bay and the return train at 6.15 p.m. to Ellon and from Boddam at 7.15 p.m.

On the Deeside line the 8.30 a.m. from Ballater reaches Aberdeen, with three stops, at 9.36 a.m. (43¼ miles), with the 4.45 p.m. corresponding train back, due at Ballater at 5.50 p.m. There is also the 1.15 p.m. on Wednesdays and Saturdays to Ballater, returning at 8.15 p.m. On the Peterhead and Fraserburgh section the 4.38 p.m. from Aberdeen, express to Ellon, and the 5.45 p.m. semi-fast return train may be noted.

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Leaves from the Log of a Locomotive Engineer [No. XXIX.].

Methods of Dealing with Railway Accidents or Breakdowns.

By ROBERT WEATHERBURN.

ONE of the most fascinating phases of railway work is dealing with accidents and breakdowns. Owing to the rapid improvement in all branches of railways, such as signals, permanent ways, rolling stock, accidents are far less numerous than formerly. The exclusion, as far as possible, of the human factor by automatic or semi-automatic appliances and the further increase in quality and strength of materials have largely contributed to this diminution. Yet however good the system or measures adopted, their very excellence, reliability, or interdependence acts prejudicially at times by undermining the human factor in the qualities of care and initiative; so that, though less in number, the accidents that do and will occur will be equally as serious in their character as formerly. The increase of power (in additional size of cylinders and boilers) necessary to economy of railway working has raised the centre of gravity considerably higher, which, although of little consequence under normal conditions, may result in overturning in collisions or derailment at high speeds, with further painful contingencies.

In the mixed-up and chaotic wreckage caused by a severe collision (where order has given place to and become an orgie of confusion) it too often happens that much time is wasted, either in too precipitate action, or by being uncertain as to how or where to commence. The first object should be to restore as far as possible the normal conditions of working; that is presupposing that accidents to life and limb have been effectually dealt with. Yet there is much that can be dealt with in clearing the way to the central sphere of action without thoughtlessly blocking the way by premature and ill-judged attempts at removal.

The present means are ample, as a rule, if only properly directed and used by well-trained men. The able, tactful worker with a cool head and right understanding will assuredly find his way to the front if allowed. There is no mistaking such, they make their presence felt by some action or suggestion of an anticipatory nature, which is immediately recognised by the initiated and becomes a note of reference in human valuation and preferment.

Given time, the most ordinary commonplace gang with modern appliances at its disposal will clear away the wreckage, but time is of the greatest import, not only to restore the interrupted stream of traffic, but also to rehabilitate public confidence by the speedy removal of every vestige of misfortune. In the ordinary way of dealing with the broken and jumbled-up mass resulting from a collision, it is more a question of hard work, seasoned with tact and discretion, rather than ingenuity in separating, slinging, lifting, and loading up. To traverse the area of such a subject in its general or broader aspects would require too much time and space; therefore I will confine myself to instancing a few accidents which belong to a class too well-known by experienced railway men, as not severe but bothering or difficult to come to grips with without incurring serious and disproportionate delay.

One day when I happened to be doing business with Mr. John Kendal, the then locomotive superintendent for the Rhymney Railway, he was informed that the line was blocked at a critical part of the road in constant use by the Taff Vale, Rhymney and other trains. I accompanied him to the scene, meanwhile discussing the subject in hand. On our arrival the object of trouble showed itself to be a six-wheeled coupled outside cylinder engine, with the right-hand bottom slide bar hanging down at the carrying bracket end, and wedged fast endways between the cylinder cover and a long junction sleeper. The piston rod, with crosshead attached, extruded and was bent to the extent of about 1½-2 in., taking that as the versed sine of the arc of semi-circle which it formed, thus preventing its being forced back, which was absolutely necessary, as the crosshead jammed the dislocated slide bar; and as the wheels were small and cylinders low, the depending parts prevented movement either way

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Those who know the awkward relations which existed at that time between the two companies, and the number of loaded trains coming down from the hills—which had already gathered in a long queue—may better realise the position. Here was a simple but rare breakdown, no derailment, but the engine jammed and immovable in both directions. The connecting rod had already been disconnected, the coupling rods still in their place. To force up and partly straighten the bent piston rod required at least a powerful foot-jack. Tangye jacks were not then in active general use, and certainly not available. At least three trains each of 60 loaded coal wagons were behind; dock hoists, tips and ships waiting; officialdom, always prominent at such times, was urgent to know when and what was going to be done, and how long it would take to do it?

It seemed so simple to knock out the slide bar which was strutted by the bent rod. Of course it could be taken down in a variety of ways, it was only a question of time, but that to Mr. Kendal was everything. He was a practical man and a born mechanic. One glance at the worn gland, for the engine was ready for the shops, then seizing a hammer and chisel from the footplate, he quickly knocked out the bolt which connected the valve link to the spindle, forced back the slide valve a little, until the back part was fairly open. He then shouted to the driver to keep her in mid-gear, and then give her the full head of steam quickly, and—presto, at least seven inches of the quivering piston rod was drawn reluctantly in, and the bar was speedily relieved.

The engine was now movable, and most certainly the whole time occupied was not more than seven minutes. Like the balancing of Columbus' egg, I can imagine some of my readers saying, "Well there is not much in that." The skippers and their ships, the docks and their dues, etc., answer.

One winter's morning in the year 1886, Kentish Town Locomotive Department was notified that the break-down vans were required at West End sidings. The situation was as follows, two coal trains with their engines had occupied adjacent sidings which converged on the same road. Both were awaiting "Peg off," when unfortunately a mistake was made by one driver in accepting the other one's signal. Both trains moved to the same exit and before the mistake could be rectified they came shoulder to shoulder in collision, each as it were trying to shoulder the other off the road. The force of contact was sufficient to damage the buffer plate ends and smash the foot-plating in that vicinity. One of the tenders was also derailed. The affair, although not serious, on examination revealed a difficulty in handling as the coupling rods appeared to have got interlocked at the leading ends. But what was worse, the two engines were partly forced over at a most dangerous angle giving the impression that any disturbance might cause them to fall over on their sides. The wheels of both engines on their sides of contact were lifted bodily above the rails about 6 or 7 in. the flanges of the wheels on opposite sides acting as a hold and fulcrum of leverage which alone prevented them leaving the road. It was a strange position, each engine seemed to be resting on the other, but likely to slip any moment.

It was still dark and the unballasted rails and sleepers and the dangerous angle of each engine suggested the need of great care in any operations to disentangle. The first operation was to uncouple and withdraw the trains to make room, and the uncoupling and rerailing of the tender. This accomplished, I had scope then for putting into operation an idea that had struck me whilst ineffectually trying to make out the interlocking of the coupling rods amidst the broken foot-plating.

Whatever the conditions might be it was too dangerous to attempt lifting or jacking operations, as any slip or release of the wheel flanges would most probably with the depth of rail precipitate a turnover. My idea was this: if the converging movements had placed them in that position and caused an interlocking of the coupling rods, a diverging movement would cause a release! The only difficulty was that owing to the angle attained by the two engines, there were only six points of contact with the rails instead of twelve, and that owing to the tangle, both engines must be moved together and in unison as one engine. It was with some difficulty that I got the drivers to mount their inclined footplates, and first arranging the pressures to be the same at a given signal, both engines moved at the same moment backwards amid some considerable noise and jolting, I was rewarded by seeing them safely on the rails without a jack or packing being used for them. A brief examination showed nothing of a serious nature to prevent them working their trains to their destination.

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Photo] [. *Richardson.*

NEWCASTLE-BRISTOL EXPRESS LEAVING OXFORD.

Great Central train, Great Western locomotive No. 3702 *Halifax.*

The Compilation of a Passenger Traffic Time-Table.

By D. W. HARRISON and J. P. GRIFFITHS.

WHILST on the station platform awaiting the arrival of the train to convey one to business, or returning in the evening, the remark is often overheard "I wonder why the train is late"; and generally a discussion ensues in which the railway company is condemned for not running the trains to scheduled time, failing to introduce a more frequent service, and the lack of accommodation on certain trains, while other grievances are ventilated feelingly. The English travelling public has a tendency to become hypercritical, and probably if made aware of the intricate manœuvrings involved in the compilation of the passenger time-table, in an endeavour to cater for the needs and comforts of all classes, would be inclined to view with less disfavour a system which is without a parallel in the world. It will probably prove interesting to briefly review our passenger train services, how they are built up, and the difficulties railway officers have to contend against and overcome to obtain the most satisfactory results and afford the travelling public the best possible facilities.

The nature of the traffic during the summer and winter months is divergent, comprising in the former season a preponderance of passenger trains, necessitated by the demand for facilities to visit seaside resorts and places of interest throughout the country, with a considerable increase in the quantity of coal to be transported during the winter. Different services of trains are, therefore, essential and just prior to May and October the question of the issue and publication of a new table is gone into, and the original services are reconsidered in total

As the passenger and other services are interdependent they must be considered together, and thus the Company prepares for its own and staff use a working time book which shows the timings of the whole of the trains. Trains must be classified in the order of their importance: express passenger, slow passenger, perishable, express goods, slow goods and mineral. The long-distance expresses—some of which carry mails—rank first, and these form the framework of the table. Usually they only call at important centres from which places branch out the local and through services in all directions. As these trains centre mostly upon the Metropolis or from port to port, the chief considerations are the connections with other trains and the boats, and the most economical use of locomotives and the rolling stock. It is observed that such trains are seldom interfered with, and from this fact it is occasionally urged that railway companies are not so progressive as they might be in this direction.

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The effect of a new train between Manchester and London in each direction is scarcely appreciated by the general public, but in practice they are far-reaching. In the first place, it would mean the provision of two additional locomotives and one or perhaps two sets of carriages; but a further and more important consideration is the dislocation which would result in traffic working. The speed at which trains travel varies from that of a heavy mineral train at ten miles per hour to an express at 60 or more miles per hour, and the slow passenger, express goods, perishable and slow goods all range between these figures. At an important point, say a long tunnel on the main line, it is easy to imagine the amount of shunting and standing time involved should an additional express be introduced into the service, as it is essential between points where there is no accommodation for berthing, that preceding trains should have sufficient time to get through, and if the required margin is not available they must be held up. Further, this additional train may be so timed that it is not possible to get a goods train through certain vital sections before another passenger train is due. The resultant expense from standing time and general interruption of working would probably exceed the revenue derived from running the train.

It is, however, with the running of slow passenger trains that the most fault is found. The workman whose train drops him off at a local station complains that he is at his work twenty minutes too early, and asks why cannot the train be put back a quarter of an hour, entirely overlooking the fact that if his wish were acceded to the train would not be sufficiently early to allow his fellow travellers to proceed to a point beyond his own destination and be in time for their work. It is the same on his return home in the evening; why cannot the train be run earlier, or why is it a few minutes behind time? He does not know that a horse-box has perhaps been attached at a preceding station, a large number of parcels have had to be dealt with, or the delay is due to some other exceptional occurrence. Passengers themselves do not always assist the officials in their desire to maintain punctual services, as they saunter down the platform looking for empty compartments, and have to be continually urged to "take your seats, please."

All applications and complaints from the public in regard to the train service receive consideration when the time-table is under revision. If compliance with any of these requests affected only the trains under notice, it would probably not be unreasonable to expect this to be done, as it often is, but interference with existing trains frequently demands extensive rearrangements of so many others that such a change can only be decided upon after mature deliberation. Requests for alterations, too, in many instances, do not carry with them general support, and it is necessary to obtain a consensus of opinion from all continuously travelling by the train. It is generally found that the majority do not favour any alteration in the existing arrangements.

Travellers may desire the company to include additional stops, or to continue a train beyond a point to which it is booked to run instead of having to await a connection. These generally refer to business trains in the morning and evening, but the result would be an interference with other passenger trains, and necessitate their being run so much earlier or later that it would mean satisfying one complainant and inviting a hundred others.

The whole of the working being so interlinked, it is essential in effective operation that each and every train should reach certain junctions at the times they are tabled to arrive, as if one should be a few minutes behind other trains are detained and eventually miss their turn at the next junction. So much importance is attached to the running of all trains that even the slightest delays are rigorously enquired into, with a view to obviating them in future. Congestion and dislocation resulting from delay is so serious a matter from the railway point of view that in the company's own direct interests no stone is left unturned to reduce them to the smallest possible minimum, and to anyone having an opportunity of scrutinising the records of time lost by passenger trains, which have the greatest effect on the general working, and bearing in mind the volume of traffic to be transported, the instances of serious delay are practically negligible.

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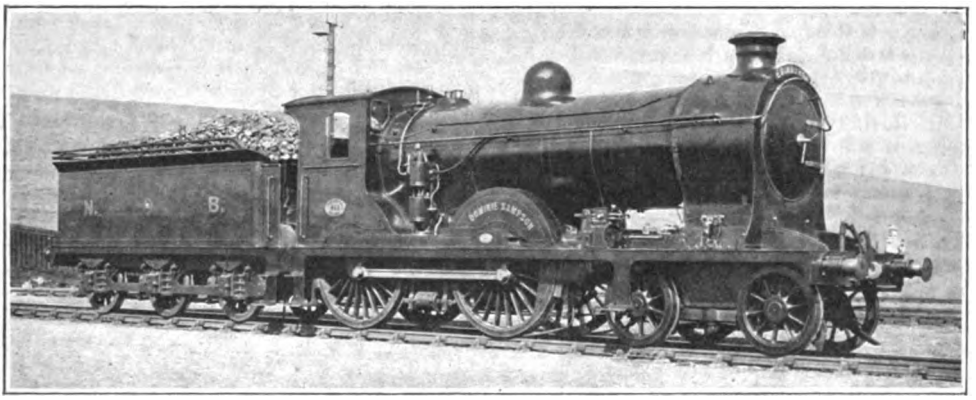
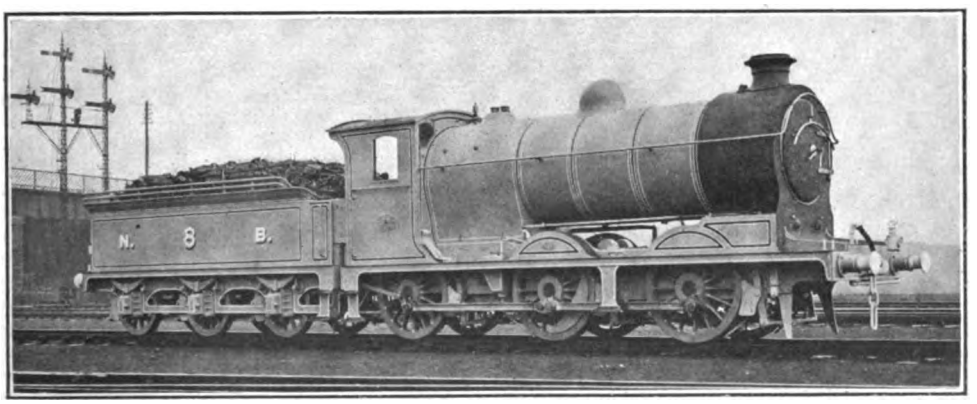
New Locomotives on the North British Railway.



NEW 4-4-0 SUPERHEATER EXPRESS LOCOMOTIVE NO. 411 *Dominie Sampson.*
Designed by Mr. W. P. Reid, Locomotive Superintendent.

Last year Mr. W. P. Reid added fifteen further 4-4-0 express locomotives of the "Scott" class, fitted with the Robinson superheater. The names and numbers of some of them have already been given, but the complete list is as follows:—409, *The Pirate*; 410, *Meg Dods*; 411, *Dominie Sampson*; 412, *Laird o' Monkbarns*; 413, *Caleb Balderstone*; 414, *Dugald Dalgetty*; 415, *Claverhouse*; 416, *Ellangowan*; 417, *Cuddie Headrigg*; 418, *Dumbiedikes*; 419, *The Talisman*; 420, *The Abbot*; 421, *Jingling Geordie*; 422, *Kenilworth*; 423, *Quentin Durward.*

Mr. Reid has also introduced a new superheater goods class, as illustrated below. Cylinders are 19½ in. by 26 in.; coupled wheels, 5 ft. diam.; heating surface, 1,732·22 sq. ft.; grate area, 19·8 sq. ft.; working pressure, 165 lbs. per sq. in.; capacity of water tanks, 3,500 gallons; total weight of engine and tender in working order, 93 tons 11 cwt.



NEW SUPERHEATER GOODS ENGINE, NO. 8.
Designed by Mr. W. P. Reid, Locomotive Superintendent.

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PERTINENT PARAGRAPHS

Southward Bound.

LAST month our frontispiece showed a "Northward Bound" train leaving Euston for Scotland; on this occasion we give as a companion view a striking picture, from a photograph by Mr. R. J. Purves, of an East Coast express passing off the King Edward Bridge at Newcastle-on-Tyne, "Southward-Bound" for York and London. The train in question is the 2.20 p.m. from Edinburgh (Waverley), due at King's Cross at 10.45 p.m. It is drawn by one of Mr. V. L. Raven's three-cylinder Schmidt superheater "Atlantic" locomotives, No. 728, of Class Z. Leaving Newcastle at 5.4 p.m. this train is booked to Darlington in 47 min., and thence to York in 48 min.

Are Our Railways Nationalised?

THERE is still a widespread impression that the administration of our railways by an Executive Committee, appointed by the State to meet war conditions, entails, if not actual nationalisation of the railways, at any rate a sufficient approximation thereto to constitute a "precedent" for State acquisition and operation when normal times come again. That this idea should be so general is due entirely to a misconception of the problems really involved by nationalisation, and of the objects and scope of the arrangements now in operation. Under nationalisation the first difficulty would be that of satisfactorily adjusting financial aspects, a matter which is entirely untouched at present. In fact, a main reason for the railways being taken over to the extent already done was to overcome the difficulties of working them to meet the special requirements of the situation, and to provide for a suitable basis of remuneration by substituting a simple financial arrangement for the complex conditions associated with doing *the same work* according to ordinary methods. In other words, instead of paying for all the special work involved by the war on the old basis of settlement through the Railway Clearing House, details being settled between the respective companies, a simple basis of payment is substituted therefor which takes no account of the details. Incidentally, this also simplifies traffic working by doing away, for the time being, with the complications associated with the limitations of individual ownership of lines and material, and enables the Government to demand precedence as the right of the controlling factor, instead of as a matter of courtesy or consideration rendered by the railways to the State. Otherwise, each railway is attending to its own business as usual, except as far as it is affected by national requirements, while the main financial considerations, the crux of the nationalisation problem, are unaffected.

A Tribute to Railwaymen at Home.

SPEAKING recently in Edinburgh, Lord Rosebery remarked upon the important work performed by railwaymen under present conditions in the following terms: "We all know how much we owe to those servants of the public. When we think of the enormous responsibility placed on the engine drivers and the signalmen of a line, who have at the mercy of their reason and sobriety the lives of any number of their fellow-countrymen; when we think that every guard in charge of a train has under his responsibility a mass of his fellow-creatures, whom carelessness on his part may easily launch into eternity, I think we do not need to overestimate in any feature the services rendered by our railwaymen. And they at this moment remember, are serving their country as truly as any man in the trenches. They are conveying our troops to and fro; they are rendering inestimable services in bringing the wounded from Southampton to Scotland with a rapidity which, I must say, has astonished me. I say these men are as truly serving their King and their country as any man in the trenches."

Railway Finance.

CONSIDERABLE uncertainty has prevailed as to the financial prospects of holders of home railway stocks and shares, and Mr. W. J. Stevens, writing in reference thereto, may be quoted in a succinct summary of the present position. He points out that the "satisfactory arrangements which the Government have been able to make with the railways regarding their remuneration under the Regulation of Forces Act, 1871, has also served, no doubt, to help the Home Railway market. Even the Ordinary stockholders may expect to receive their dividends as usual during the course of the war, and the actual conditions of the arrangement with the Government provide that on the average these dividends will be somewhere in the neighbourhood of those paid for the year 1913. One other contributing cause of strength in this market has also been the absence of any large foreign interest."

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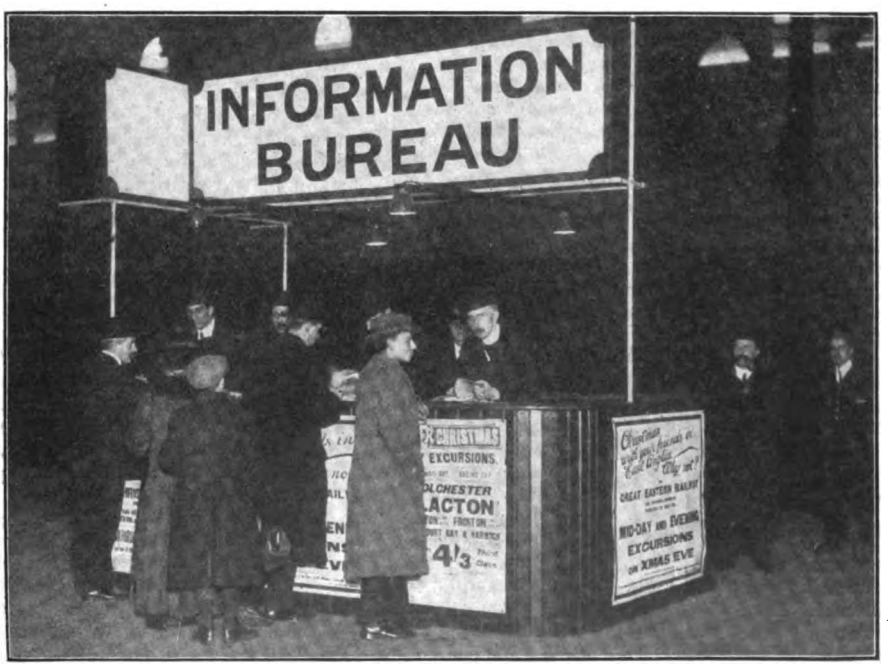
Changes in Railway Traffic Conditions.

In many ways railway traffic at Christmas was essentially different from that of previous years. In volume it was probably as large as ever, possibly even heavier, and certainly more difficult to work. In place of a proportion of general traffic there was an enormous amount of "leave-travol" on the part of the Forces, with the added difficulty that the pressure was felt in ways for which there is no precedent. Fog added greatly to the difficulties of traffic working on Christmas Eve, but there is no suggestion that the railways were overtaxed, though the arrangements made included many features of a special character. This is indeed a characteristic of a large propor ion of present railway travel. Stations which ordinarily are quite secondary now account for large traffic, stations which are usually very busy ranking below the normal, and specials having to be run to serve stations which have only achieved traffic importance owing to the new conditions. In addition there is the enormous mail and parcel traffic, again distributed very differently from the usual course, and as far as can be gathered, at Christmas this was much heavier than is ordinarily the case. As a rule, railway arrangements for Christmas traffic are based upon the experience of previous years, and have grown by a gradual process of development. This year no precedents beyond war experience were available; yet there is every indication that the task set was capably and satisfactorily carried out, except for such allowances as were inevitable to a foggy Christmas Eve.

For the Christmas traffic two "Information Bureaux" were erected on convenient platform spaces at Liverpool Street, Great Eastern Railway. The ordinary enquiry office is sufficient for normal requirements, but at busy periods becomes overcrowded; hence the erection of these information centres, conspicuous to everyone, and, needless to say, amply justifying themselves. One was placed in the open space at the rear portion of No. 9 platform, adjacent to the main line booking offices, and near the principal train indicator. This is the one illustrated on this page. Standing to the left, conferring with his assistants in charge, can be seen Mr. E. A. Evans, in charge of advertising on the Great Eastern Railway. The other stand was placed near the cab rank in the East side portion of the station.

Another feature of railway travel since war conditions commenced is that, on Sundays in particular, many excursion trains are being run, or excursion tickets issued by ordinary trains, to places which are not so favoured even in the summer months, some of them almost unknown except locally. The explanation is, of course, that the places so served are now centres of military encampments and depots, and the special provision is made to enable people to visit relatives and friends now serving in Lord Kitchener's Army or other branches of the national forces. Other excursions give similar facilities, and are based upon the same requirements.



Photo] [*Topical.*

INFORMATION BUREAU ERECTED FOR THE CHRISTMAS TRAFFIC ON NO. 9 PLATFORM AT LIVERPOOL ST., GREAT EASTERN RAILWAY.

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A Midland Souvenir of the War.

UNDER the title of "For King and Country: Midland Railway Employés and the Great War," this Company has issued a well-produced souvenir giving the names of 7,531 Midland men who had joined the Colours up to November, 18th, 1914, together with the names of those included in the casualty lists so far as the information was ascertainable at the time of publication. According to the latter tables, 61 late Midland employés have lost their lives, 14 are reported as missing, 60 are prisoners of war, and 215 have been wounded or invalided home. The booklet fills nearly 200 pages, and is prefaced by an address to the staff by the General Manager, Sir Guy Granet, as follows:—

"To the members of the staff.

"The Press has stated that the railways of the country have already provided the Army and Navy with a force numbering about 60,000 men. The Midland Railway contribution to this total is considerable, and, no doubt, the staff will be pleased to have any available information concerning their comrades."

"Within a week after the issue of the Mobilisation Order on August 4th, 1,838 Army and Navy Reservists had joined the Colours, and 1,462 Territorials had assembled at the allotted centres."

"Since those early days a continuous stream of volunteers has flowed from the railway ranks; indeed, so strong was the current at one time that there appeared to be some risk of certain branches of the service becoming depleted to such an extent as to impair the efficient working of the railway. The maintenance of inland transport is of vital importance to the nation, and, therefore, it became necessary to require each man desiring to enlist first to obtain permission from his superior officer. This sanction has been withheld in comparatively few cases only."

"Every rank and every department of the Midland Railway service is represented in the Forces. The following officers are already either with the Army or Navy in the fighting area, or are on duty at one or other of the various training camps, etc., in this country." A list of names is then given including:

Major C. W. Paget, General Superintendent.
Major L. Sandwith, Stores Superintendent.
Major P. M. Payne, Rating Surveyor.
Major J. A. Henderson, Chief of Police.
Capt. W. H. C. Clay, Estate Agent.
Capt. K. R. N. Speir, Divisional Superintendent.
Major F. N. Butler, an assistant to the Stores Department.
Capt. F. M. Donne, District Locomotive Superintendent, Nottingham.
2nd Lieut. G. C. Schultz, District Locomotive Superintendent, Leicester.
2nd Lieut. H. Rudgard, District Locomotive Superintendent, Plaistow.
Capt. F. W. Abraham, District Locomotive Superintendent, Derby.
Capt. J. Kerr, Marine Superintendent, Heysham.

Railwaymen with the Colours.

SINCE the list given in the January number the number of Great Western Railway men who have joined the national forces has been further increased, and the following later statistics will be of interest:

Department.	No. of Men.
General Manager's	12
Secretary's	10
Chief Accountant's	30
Solicitor's	4
Passenger	1,483
Goods	1,512
Locomotive	4,239
Engineering	1,337
Signal	318
Electrical	45
Stores	79
Audit	74
Marine and Docks	96
Hotels	105
Rates and Taxes	2
Estate	6
Stationery	6
	9,358

South African Railways and the War.

OUR South African contemporary draws attention to what is termed the extra-departmental services which the Railway and Harbours organisation in South Africa are rendering to the State. Some 8,000 members of its staff are serving the country in a military or semi-military capacity, while many thousands more are preparing by drill and training to fit themselves for any emergency that may arise; but apart from these praiseworthy efforts there are many other ways in which the Government and its military advisers are being assisted by railway workers and the railway organisation. To aid the Government in every possible way has been the aim of the Railway authorities, and with this object in view the help of the staff, and the very useful aid afforded by the employment of many mechanical appliances, have been freely forthcoming.

A Railway Construction Record.

THE completion of the railway between Prieska and Upington is claimed to constitute a record in the history of railway construction in South Africa. There were special reasons why the work should be carried out with all the expedition possible, and there were also special difficulties which hindered and hampered those in charge of the construction. Platelaying was started at Prieska on September 7th last and the temporary terminus at Upington was reached on November 20th. This nominally means 75 days on the work of platelaying and linking in sidings, but, out of those 75, eight days were totally lost and various other days partially lost owing to military traffic. The total length of track laid, including permanent and temporary sidings and slips, was 153 miles, with 60 sets of points and crossings. This gives an average of two and a

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quarter miles of track laid per day ; and a record of platelaying was achieved in the 24 hours from midnight November 1st to midnight of the 2nd, during which time three and a quarter miles of platelaying was done and six hundred tons of material handled. The staff engaged in handling this material consisted of three engineers, eighteen white workmen and, approximately 300 natives. Over 300 construction trains have passed over the line, irrespective of water and supply trains, one of which ran daily, and in addition to these nearly 100 military trains have passed over the line.

The Esquimalt and Nanaimo Railway.

REFERRING to the article published last month on the "Esquimalt and Nanaimo Railway," Corp. C. F. Palmer, now in this country with the Canadian Forces, writes us as follows—

"This line now has its northern terminus at Port Alberni, some considerable distance north of Wellington; there was also a new branch opened to Courtenay this summer. The line is worked by the Canadian Pacific Railway, who also maintain an excellent steamship service between Vancouver and Nanaimo. The fast turbine steamer *Princess Patricia* makes two return trips daily at 7 a.m. and 3.15 p.m. during the summer months from Nanaimo to Vancouver During the winter months only one trip daily is made, leaving Nanaimo at 8 a.m. and Vancouver at 6.30 p.m. The distance between the two ports is about 40 miles, which is covered in two hours. In addition to this there is a car transfer service from Ladysmith to Vancouver. By this means it is possible to run freight cars from all parts of the mainland without unloading their contents at Vancouver. On war being declared last August, several trains of guns, ammunition, etc., were sent *via* this route direct to the forts at Esquimalt, thus saving an immense amount of time and labour. The transfer barges, which have three tracks, with room for about 15 cars, are towed by powerful Canadian Pacific Railway tugs, the journey between Vancouver and Ladysmith taking about 4 hours. During last year the traffic of the line increased considerably, there being several freight trains each way daily, including Sundays."

Lord Roberts' Funeral Train.

ON the occasion of Lord Roberts' funeral at St. Paul's Cathedral it was stated that although the special train travelled from Ascot over the London and South Western Railway, and was worked by a London and South Western locomotive, the terminus selected for its arrival in London was Charing Cross, South Eastern and Chatham Railway. Several readers have asked particulars of the route followed, and on taking up the matter with the officers of the London and South Western Company we are informed as follows: The train was composed of South Eastern and Chatham rolling stock, but was worked by a London and South Western locomotive from Ascot *via* Twickenham, Richmond and Barnes to Clapham Junction, thence transferring to the Wandsworth Road—Brixton route to Blackfriars Junction. Under South Eastern and Chatham direction, but still with the South Western engine attached, the train was backed to Metropolitan Junction, thence running into Charing Cross. The engine returned light to Clapham Junction over the same route, thence proceeding to Nine Elms. The engine was booked to leave Nine Elms at 7.30 a.m. and travel light *via* Surbiton, Woking, Pirbright Junction, and Camberley to Ascot, due at 8.30 a.m., the special leaving Ascot at 9.15 a.m., passing Clapham Junction at 9.53 a.m., and reaching Charing Cross at 10.28 a.m.

Hospital Train on the Great Indian Peninsula Railway.

FOR use in conjunction with military manœuvres carried out in the Poona district, operations culminating in a mock battle in which nearly 20,000 men were engaged, the Great Indian Peninsula Railway equipped a complete hospital train for conveying "wounded" from the battle area to the base hospital. The train consisted of ten cars vestibuled throughout: (1) Brake van for kit of wounded, baggage and stores; (2) restaurant and sleeping car for medical officers and nurses; (3) car for wounded officers, British and Indian; (4) Indian medical staff; (5) open car, with beds for serious cases; (6) open car, with beds for serious cases; (7) British medical staff; (8) Indian wounded, sitting; (9) Indian wounded, sitting; (10) brake van for kit of Indian wounded. The "wounded" were brought to the train by steam tractors, motors, mule bullock, and hand ambulances, almost every conceivable form of transport being utilised, and after treatment by the doctors were comfortably accommodated in the cars.

Springburn Hospital: North British Locomotive Co., Ltd.

As evidence of the desire of engineering firms to render what help they can during the war, may be mentioned the Springburn Hospitals opened by the Scottish branch of the British Red Cross Society in the administration building of the North British Locomotive Co., Ltd., at Glasgow. The firm have provided within their building a complete hospital of 150 beds in three large wards, named after the three works of the company, "Hyde Park," "Queen's Park," and "Atlas." Besides an operating theatre and X-ray room, accommodation within the building is provided for resident doctors and a staff of over thirty nurses. A passenger lift and twenty-four baths have also been installed by the firm. The hospital has been equipped, and is being operated by the Scottish branch of the British Red Cross Society.

Audible and Other Cab Signals on British Railways.

IT was a good idea of the Institution of Mechanical Engineers to arrange for a series of papers on this subject to be read and considered at the same meeting, held on Friday, December 18th. The authors were Messrs. W. C. Acfield, Signal Superintendent, Midland Railway; Leon

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P. Lewis, Caledonian Railway; Vincent L. Raven, Chief Mechanical Engineer, North Eastern Railway; W. A. Stanier, Great Western Railway; and W. Willox, Chief Engineer, Metropolitan Railway. Mr. Acfield's paper dealt with the conditions and requirements and certain requirements of audible signalling on trains in motion, but did not include descriptions of apparatus employed. Mr. Lewis considered more particularly the general aspects of automatic signalling on trains. Mr. Raven's paper was concerned mainly with his electric system of cab-signalling as employed on portions of the North Eastern Railway. Mr. Stanier described the combined automatic train control and audible signal system in use on the Great Western Railway, and Mr. Willox dealt more particularly with train stops as employed on the Metropolitan Railway.

Audible Signalling on Trains in Motion.

After introducing his subject Mr. Acfield specified the general requirements as follows:

(*a*) Warning to engine-drivers of train approaching signals either at danger or clear.

(*b*) Distinctive sounds for danger and clear signals.

(c) Absence of apparatus operated by the force of impact.

(*d*) Gradual application of train brake in the event of a danger signal being received, and means of liberating the brake on the part of the engine-driver.

(*e*) Apparatus, in the event of the failure of any part, should give a danger signal.

(*f*) Elimination of movable ramps operated by signalmen by mechanical means.

(*g*) Impossibility of signals being in contrary position to the position of the levers in the signal-box working the same.

He expressed the opinion that sirens appear to be the most desirable form of warning as a danger signal, operated either by steam or by air-brake, and a bell for the clear signals. An attempt has been made in some systems to provide clockwork recording apparatus working in connection with cab-signalling devices, with the object of showing definitely and placing on record each time the apparatus is operated when a signal is passed at danger; this, no doubt, is an ideal system, but, it is suggested, of not much actual value, as an immense amount of work would be entailed in checking these records, which would doubtless necessitate an increase in the staff of the department responsible.

In conclusion he mentioned that the Midland Railway have not adopted any cab-signalling device up to the present time, but have experimented with the Combined Automatic Train Control and Audible Signal System, as used on the Great Western Railway, on a branch line for which two engines have been fitted with the apparatus, and so far the experiments have proved satisfactory. The Midland Railway has also made experiments with the Railophone, for giving an automatic warning in the engine cab. This apparatus differs from anything hitherto brought out. It is primarily intended for use in connection with distant signals, and, unlike the Automatic Train Control mentioned, has no physical connection or contact with either the rolling stock or permanent way, being operated entirely on the wireless inductive principle.

Automatic Signalling on Trains.

Mr. Lewis dealt first with the principles of signalling, the necessity for route signalling, the automatic feeding of detonators, the general principles of cab signalling, the need for a warning signal on the engine, and other factors, incidentally reviewing the trend of invention in reference thereto. He expressed the opinion that before any mechanical device can be made generally suitable for railway service, the following requirements must be met:—

(1) The standard loading and structure gauge must be recognised.

(2) The moving parts on the engine must have the smallest possible inertia.

(3) The portion on the railway must be sufficiently strong to withstand the impacts received in service, and yet must be such that it can easily be operated at a considerable distance from the signal-box.

(4) The apparatus must serve for engines running either chimney first or tender first.

(5) It should be suitable for working over single lines, where trains run in both directions over one pair of rails.

In reference to electrical automatic signalling he remarked as follows:—The use of electricity in some manner, however, appears to give promise of a successful scheme being possible, and for many years experiments have been made to discover an electrical or an electro-mechanical solution of the problem. With electrical devices it is essential to scrutinise closely all the details, to be certain that in all circumstances, should any part of the apparatus fail in service, a false clear indication shall not be possible. Most electrical systems employ ramps of various lengths and in number depending on the scope of the device. There is no difficulty in designing a good working insulated ramp, as with electrical ramps no movement of the ramp is required. The portion on the engine at the most has to open or close electric contacts, which need possess little inertia. Where brushes are used for making contact with the ramp, there is some difficulty likely to be experienced in maintaining them in such a condition that they will clean the ramp and ensure a good electrical contact in all weathers, and if the brush is intended to operate a danger indication, there will be the risk of a defective brush failing to perform this important duty, and it is hardly possible to provide a detector to inform the driver when his brush has failed. Some device, which can be relied on to inform the driver, should the contacts not be in working order, is necessary so far as the indicator of danger is concerned. Various practical aspects were then discussed.

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The Raven Electrical System of Cab Signalling.

THIS system has been in actual use on the Richmond branch of the North Eastern Railway for over two years and also on the North Eastern Railway main line between Durham and Bensham, and during the whole of that time the arrangement has given every satisfaction; and on no occasion has the danger signal ever been omitted to be given. The apparatus is fitted to thirty-six locomotives.

The main objects of the system are :—

(1) To advise the driver of his approach to a signalling zone where signals are to be looked for.

(2) To give the driver the necessary information with regard to the position of the signals controlling his further advance, and to prevent him from mistaking other signals than his own.

(3) To retain control of the driver by the cab-signals until he has passed the last signal-controlling entrance into the section ahead.

The system comprises visual and audible indicators, and the apparatus is electrically operated. The visual indicators on the engine consist of a small semaphore with which is combined one or two small pointers capable of being deflected to indicate numbers painted on the dial. The semaphore arm, together with the operation of the small pointer, indicates "condition" signals, and the small pointer, by the number indicated on the dial, also gives the "route" indication. The audible indicator is an electric bell, which is separate from the visual apparatus.

The engine circuits are brought into operation by the movement given to a metallic shoe linked to a small switch when passing over metallic bars placed in suitable positions on the track, and currents are collected from the bars by insulated steel wire-brushes lightly but firmly over the bars as the engine passes over them. The shoe and the brushes are carried on one bracket, which is insulated from the engine frame. The metallic bars on the line are mounted on insulators.

Two forms of apparatus are in use. The only difference in the indicating arrangements is that one has two "route indicator" pointers, and the other has only one "route indicator" pointer. One "route indicator" pointer is sufficient for a two-way diverging junction, and two pointers only are required for three-way or four-way junctions.

The apparatus may be used partially or wholly as described, where the conditions of service require less than on fully developed railways. It is capable of being adapted to show signals for distant, home, and advance signals where the present outdoor system is to be retained, or it may be adapted to work with the present distant signal only. It can be adapted to single line working, and lends itself to the provision of records of the "condition" signals obtained at each signalling point, should such records be considered desirable. It is also capable of acting as a means of indicating points at which temporary speed restrictions are imposed. The design of the apparatus is such as to give the fullest possible indication of failure of the equipment. The normal operating position of the semaphore arm is maintained by a continuous current, any interruption of which places the semaphore arm to danger, and inability to restore the arm to the normal running position is proof of such failure. The arrangements by which the warning and danger signals are given by the mechanical raising of the shoe, obviate the necessity for relying upon the making of electrical contact with the bars of the track for the giving of these signals, and any failure to make such contact has only the result of causing off signals to be missed, and so does not in any way result in dangerous action. The apparatus is self-testing during the whole time it is in operation.

The Great Western System.

IN introduction, Mr. Stanier specified the following requirements as having governed the work of the Great Western signal engineers in developing their apparatus :

(1) An audible warning on the foot-plate of the engine, to inoicate to the engineman the position of the signal he is approaching.

(2) The warning must be separate and distinctive for stop or danger position and the proceed or all-right position of the signal.

(3) The stop or danger warning must be independent of any electric connections either on the line or the engine, and must be given, even if the electric connections fail.

(4) Each signal must be acknowledged by the engineman in some tangible way.

(5) It must be possible to apply it to any engine, and to any line whether single or double.

(6) There should be no moving parts on the line.

(7) Latterly it has been decided that in the event of the signal being at danger, the brake must automatically be applied.

About the year 1905 some of the Great Western engineers devised an audible signal for the locomotive cab, which, after a certain amount of experimenting, was considered to be simple enough and certain enough to warrant a more extended trial. It was agreed to equip certain branch lines with the apparatus, and as a result the system has had certain improvements, and its use has been considerably extended. This device met the foregoing requirements as follows :

(1) A bell and a whistle or siren on the foot-plate of the engine.

(2) A whistle or siren sounded for stop or danger and a bell for proceed or all-right.

(3) The stop or danger signal is not dependent on any electric connection to sound, and the failure of any electric connections does not prevent it sounding.

(4) The engineman acknowledges either signal by a definite movement to reset the device.

(5) The apparatus is in the centre of the track, so that it makes no difference which way the engine is running.

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(6) The ramp in the centre of the track is a fixture.

(7) When the stop or danger signal is given on passing over the ramp, a valve automatically opens in the train-pipe which admits air through a siren, and applies the brakes, thus pulling up the train.

The apparatus consists of a fixed ramp, in the centre of the track, about 400 yards before the distant signal is reached, except where the distant signal is a lower arm on a stop signal, when it is fixed at a spot just after the stop signal is passed. This ramp is connected to the lever in the signal-box controlling this particular distant signal by means of an electric wire and switch with a battery in the circuit.

In conclusion, Mr. Stanier stated that the Interstate Commerce Commission of U.S.A., when visiting this country in 1908, reported on their return: "Of the cab signal devices in use on English railways and forming the chief object of the Committee's investigations, only one namely, that of the Great Western Railway, is believed to be worthy of consideration." Col. Sir H. A. Yorke, speaking at the discussion on a paper given by Mr. A. T. Blackall, the Great Western Railway Signal Engineer, before the Institution of Civil Engineers in February, 1911, said with regard to audible cab signalling: "All that had been done on the Great Western Railway was exceedingly satisfactory. He agreed that it had the advantage of distinguishing the distant signal by night as well as by day, which was a point to which he attached a good deal of importance. No failure had taken place in which a clear or all-right signal had been given when a stop or danger signal should have been given."

The experiment on the Fairford branch, 22 miles of single line, was carried out with the full approval of the Board of Trade, subject to a report in six months' time. It has been working satisfactorily since 1906, and the automatic application of the brake when the signal is at danger removes practically the last objection to it from an operating standpoint.

Signalling on Railway Trains in Motion.

Mr. Willox commenced by mentioning that 27 miles of the Metropolitan Railway are electrified, and 23½ miles are governed automatically by track circuits. The rest of the Metropolitan Railway has ordinary lock and block signalling, with a number of sections automatically controlled by track circuits. The system of signalling in use on the electrified portion of the Metropolitan Railway is all-electric automatic, and this signalling requires no visual indication in the driver's cab. There is, however, a control on the driver by means of what are called "train-stops," which are placed at every stop signal. The train-stop is a device which is controlled by the track circuit in exactly the same manner as the signals, and consists of a short vertical arm which is held vertically in its normal position and is lowered to the clear position by means of the track circuit acting through a motor at the same time as the signal goes to clear. There is a trigger fitted on the leading motor coach or electric locomotive which would engage with the train-stop in its normal position and so be deflected backwards. When this occurs, it applies the emergency brake, on the train and simultaneously opens the power circuit, thus braking the train and cutting off the current. In this way, if a driver passes a signal at danger, his train is automatically brought to a stand and cannot be started again until the trigger is replaced in the vertical position. As showing the effect of these train-stops, it may be mentioned that a train weighing 200 tons running at a speed of 25 miles per hour on the level is brought to a stand in less than its own length.

These train-stops, although they come to a clear position at the same time as the signals, are controlled by the track circuit independently of the signals, so that if by any accident the signal should remain at the clear position instead of going to danger, the train-stop would still go to the vertical position and thus come into action if the train went past the signal. The control for the train-stop mechanism is complete when the respective track-section is unoccupied, and is in shunt with the signal control. After the train-stop motor has finished its work, that is, bringing the train-stop arm to the clear or inoperative position, the motor circuit is opened automatically by means of the motor control. The train-stop is then held in the clear position electrically by means of a clutch. The motor only operates for the actual clearing, and the clutch arrangement reduces the power for holding at clear to an almost negligible quantity.

In conclusion, Mr. Willox mentioned that the train-stops are now so fully relied upon that besides shortening the sections very considerably, fog signalling is, in some cases, now dispensed with.

The Discussion.

Mr. A. T. Blackall, Signal Engineer, Great Western Railway, dealt mainly with Mr. Stanier's paper, and referred to later developments in the apparatus, including provision now made for automatically applying the brakes when an adverse distant signal is passed. He also referred to the need for a system which, it not exactly of uniform character, would permit of signals being picked up by engines of other lines, and insisted upon the need for bearing in mind the importance of universal adaptability. Mr. Blackall and other speakers emphasised the fact that the problem is essentially one of high-speed working, as there is little doubt about the efficiency of tripping gear and like devices on the suburban electric lines with maximum speeds rarely higher than 40 miles per hour, if as much. A general disapproval of movable elements on the line was also indicated. Mr. S. L. Gibson dealt with a Swiss system, used to some extent in Canada and the United States, which apparently operated in conjunction with a train recording system. This, indeed, appears to provide for reducing speed on curves and generally safeguarding traffic, and seems to be altogether of an elaborate character,

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though the speaker emphasised that it had progressed beyond the experimental stage by referring to an installation contemplated by the Pennsylvania Railroad to cover 20 miles of line. Mr. H. Raynar Wilson spoke in favour of cab-signalling, but at the same time emphasised the great improvements already made in standard signalling. He pointed out that there are now 90 engines fitted for cab signalling on the Great Western Railway, 36 on the North Eastern, two on the Midland, besides a few others, so that the matter is passing well beyond the experimental stage.

Mr. Sayers, Midland Railway, rather objected to discussing train-stops in conjunction with audible and cab signalling as being an essentially different subject. He considered that on high-speed railways automatic train stops are no use whatever. On the Midland they had found an installation of the apparatus described by Mr. Stanier entirely satisfactory. At the same time, with the development of electric traction, he considered there was no room on the track for much else, and apparently favoured an inductive or "wireless" system, such as the "Railophone." He concluded with the suggestion that if the ordinary visual system could be made perfect, or fog dispelled entirely, as suggested by Sir Oliver Lodge, the result would be better than any possible system of cab signalling.

Mr. A. D. Jones, Outdoor Locomotive Superintendent, South Eastern and Chatham Railway, discussed the subject from a running point of view, and rather objected to the "normal clear" and "switching out" features of Mr. Raven's apparatus. He suggested that the critical period between the advent of fog and the attendance of fogmen could be met by employing devices under the control of the signalmen for placing detonators on the rail. Cab signalling and brake control are necessary together if at all. Mr. R. G. Berry, Lancashire and Yorkshire Railway, admitted the truth of rumours as to what his Company were doing, and although not in a position to describe the apparatus, he claimed that they had attained great simplicity, and had eliminated electrical features on the engine. Mr. Ansell, Great Western Railway referred to features of the Great Western apparatus.

In replying to the discussion, Mr. Acfield referred to trials on the Midland Railway, to the effect that while quite satisfactory at 40 miles per hour, train-stops were quite unreliable at 70 miles per hour. He did not favour movable ramps or the like because of mechanical difficulties. Mr. Pigg (on behalf of Mr. Raven) expressed doubts as to whether automatic brake control was really essential, and suggested that if every signal is correctly observed there would be little uncertainty as to its being obeyed. Cab signalling was designed to ensure observation. As to value in fog, Mr. Stanier quoted experience of unexpected time keeping between Paddington and Reading last winter.

The Furness Railway and the War.

In common with other leading railways, a great deal of special traffic has, since the outbreak of war, been dealt with by the Furness Railway, and we are indebted to Mr. Alfred Aslett, General Manager, for particulars of the conditions at the port of Barrow, during the war.

The Furness Railway has been largely associated with the Naval and Military Authorities in providing billetting accommodation for troops and naval ratings. Grain sheds have also been placed at the disposal of the Government for the storage of flour, etc. Munitions of War in large quantities are being provided by Messrs. Vickers, Ltd., from their extensive naval construction works, a very large number of skilled workmen being employed. The Midland Railway Company's service of steamers between Belfast and Barrow has been suspended owing to the s.s. *Duchess of Devonshire* and s.s. *City of Belfast* having been requisitioned by the Government. It is hoped, however, that the service will be resumed as soon as circumstances permit. The distribution of petroleum spirit from the extensive storages at Ramsden Dock has been exceptionally brisk and several large cargoes have recently been imported for the Anglo-American Oil Co., the Asiatic Petroleum Co., the British Petroleum Co., and the Anglo-Mexican Petroleum Co. Barrow is, indeed, becoming one of the largest oil distributing ports in the United Kingdom.

Messrs. Walmsley and Smith, who own the extensive grain warehouses and silos at Devonshire Dock, have also imported large consignments of grain. Laying up accommodation has been provided at Barrow Docks for several Belgian Line steamers from Antwerp.

Railwaymen and Enlistment.

Sir A. Kaye Butterworth, General Manager, North Eastern Railway, has issued the following circular regarding the Volunteer Training Corps:—

"As you are aware, the authorities do not desire railway servants to enlist unless they can be spared from their railway duties, and recruiting officers have instructions to ascertain this before enrolling men who are in railway employ. The reason for these instructions is that if the unrestricted withdrawal of railway servants had continued it might have seriously impaired the working of the railways for military purposes. Staff that cannot be spared from the working of the railway can, therefore, rest assured that they are as usefully employed from a national point of view as if they were on active military service. My attention has been drawn to the fact that in various centres Volunteer Training Corps and Defence Associations are being set up with a view to training men in shooting and military drill. Whilst the Company have every sympathy with the objects of such Associations, it is noticed that in some cases one of the conditions on the form of enrolment is an undertaking to be signed by the applicant that he

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places himself in the case of invasion unreservedly at the disposal of the Association. It is obvious that this condition cannot but clash with the duties of a railwayman, whose duties in the event of such an emergency would be essential for the performance of railway work, and who would not be of greater use elsewhere. No servant of the Company, therefore, can, without the specific written permission of the head of his department, allow himself to be bound to be at the disposal of any outside organisation, and any member of the staff who has already given such an undertaking should at once take steps to cancel it."

The Ilford Accident.

OCCURRING just after the series of papers on cab signalling and train stops referred to above had received special attention in the press and in railway circles, the serious accident at Ilford, which marred New Year's Day, raised with even greater insistence than it might otherwise have done, the old controversy as to the desirability of maintaining at least a degree of external control of enginemen. It remains to be seen what will be the case of the engineman of the Clacton train, as compared with that of the signalman, whose claim that signals must have been against the express is supported by the elementary principles of interlocking. In view of the fact that the suburban train was a crowded one it is remarkable that the results were not even more serious, and would probably have been worse had the collision been end-on. That so enormous and comprehensive a suburban traffic as that of the Great Eastern Railway has been handled expeditiously and safely all these years is perhaps the best recommendation the company can have. At the same time this disaster, occurring after years of immunity from serious accident affecting suburban traffic, is exceedingly to be regretted, on its own account as well as because of the death of ten passengers, some of them officers at Liverpool Street, and injury to many others, caused thereby.

The Railway Club.

ALTHOUGH the Railway Club has not yet "come of age," it is now well on the way to the attainment of that distinction, seeing that it was formed as long ago as September, 1899, and has, therefore, completed more than fifteen years of active existence. Its purpose is, as it has been throughout, that of bringing together those interested in railways, including members of the railway service and a considerable proportion of men engaged in other walks of life, but who take special interest in various branches of railway working. At the annual general meeting held on Tuesday, January 12th, the President, W. Parker, Esq., in his address, mentioned that many members have in due course become more or less well-known on account of their writings on railway subjects, while in its ordinary work the Railway Club has done much to cultivate an intelligent interest in railway matters. For a considerable period a journal was published regularly, but this was discontinued a few years ago, as it was considered preferable to concentrate upon the maintenance of well-equipped permanent headquarters, and the development of the library, now perhaps the finest and most comprehensive of its class in the world. The premises at 92, Victoria Street, Westminster, are now available for members all day and during each week evening; while the papers read at meetings always attain a high standard. At the annual meeting referred to the committee presented a good report for 1914, and showed a clear balance sheet, though the influence of the war had had its effect in reducing the balance to be carried forward. Arrangements have now been made for issuing a monthly Bulletin of announcements, reports and other matters of interest. A number of members are now serving with His Majesty's Forces, in various capacities. In presenting the report special acknowledgment was made of the presentation during the year by Mr. M. G. S. Blane (now with the colours) of a handsome cabinet and a unique collection of railway tickets of all countries. The Honorary Secretary is Mr. E. J. Miller, who will be pleased to supply further particulars of the Railway Club. At the meeting on February 9th Mr. H. L. Hopwood will read a paper on "The Railways of Wales." On March 9th Mr. Cecil J. Allen will deal with Anglo-Scottish train services.

Facing Point Locks on the Metropolitan Railway.

IN referring last month to Mr. Challis' paper read before the Permanent Way Institution on December 2nd, the use of terms in a manner liable to misconception has caused a suggestion of inaccuracy, though it is thought that the context indicates to practical men what is meant. Reference was made to the non-use of facing point locks on the Metropolitan Railway in conjunction with the installation of train stops. Actually, however, it is the facing point lock *bars* which have been discontinued. All facing points on the Metropolitan Railway are, of course, locked; but locking bars are dispensed with.

The Release Key Again.

IN connection with the accident which occurred at Cannon Street station on November 10th, when a Maze Hill train ran into the rear of a train for Barnehurst, owing to the omission of one of the signalmen to return signals to danger behind the latter train, Lt.-Col. von Donop, while rendering a tribute to the difficulties of traffic working into and out of Cannon Street station and the efficiency of "lock and block" signalling, expressed again his disapproval of the freedom with which the release key can so often be used, thereby nullifying the safeguards associated with the instruments. The Inspector remarks that "the arrangement known as lock-and-block has doubtless been effective in preventing the occurrence of many collisions, although of such cases nothing is, of course,

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heard ;· but there have been also cases, such as the one now under consideration, in which, in spite of the provision of this safety arrangement, collisions have taken place, and these cases are consequently brought to light. A large number of these latter cases, however, are not due to any actual failure of the lock-and-block mechanism, but, as on this occasion, to the failure of the 'human element' in misusing the release key, which is, unfortunately, a necessary adjunct of this system ; it is, therefore, the use of this key which calls for special supervision."

Locomotive Nomenclature.

A LONG and interesting letter from a reader revives the topic of suitable nomenclature for locomotives, and although we cannot agree with all his statements, some of his remarks call for attention. He does not consider that personal names, such as those of chief officers and directors, are appropriate, and it must be confessed that when given with initials in front and orders after the name the result is hardly euphonious, In fact, the only satisfactory reason for naming engines on this principle is that of courtesy and compliment to the gentlemen whose names are thus utilised, and the carrying out of a systematic scheme of nomenclature. Where a name reads euphoniously on its own account no objection can be taken, and frequently the surname alone, or its combination with one Christian name, satisfies this condition. For example, *Gladstone* makes an entirely suitable name for a locomotive, but if given as *Rt. Hon. W. E. Gladstone, M.P., P.C., etc.*, it would hardly rank as a good example of nomenclature. Similarly, on a geographical basis, *Hartley* could be accepted, but *Hartley Street* is less satisfactory though it might be the actual name of a station on the railway concerned. Our correspondent goes further—though why he should consider *City of London* a suitable name for a ship, and unsuitable for a locomotive engine, is not clear—and suggests that goods engines might receive titles such as *Dobbin, Darby, Bob, Captain* or *Boxer*, and other names given to cart-horses while the names of famous race-horses could be adopted for passenger engines ; though he admits that some of the names selected for race-horses are "too utterly foolish," instancing *Let go the painter*. He approves of the North British practice of naming locomotives after Scott characters, and suggests that the London, Brighton and South Coast "Atlantics" might very appropriately be named *Duke William of Normandy* (to be correspondingly numbered 1066), *King Harold*, etc. Similarly, if the London and South Western Railway named one of the 4–6–0 engines *Napoleon* and another *Duke of Wellington*, they could "meet at Waterloo."

Public Interest In Named Locomotives.

There is no doubt that the public do take more interest in named engines, and it is to be regretted that the practice has been discontinued to the extent it has. No. 326 may be sufficient for all practical purposes, but it cannot be denied that the Brighton engine which bears this number is best known and individualised as *Bessborough*. Our correspondent's letter must not be accepted too seriously, especially in reference to certain further suggestions. Thus, he proposes that the colour of engines should indicate class, or even be changed when a locomotive superintendent retires. Still there is justification for his remark that at certain stations one sees an interesting variety of engines adorned with names, while at a great centre such as York, unless a Great Central named engine or No. 990, *Henry Oakley*, Great Northern Railway, comes in, all engines to be seen there will be indicated only by numbers. In conjunction with his remarks our correspondent has carefully compiled long lists of suitable names for the Midland single and 4–4–0 classes, the un-named Great Central 4–6–0 series, the London and South Western 4–4–0's and 4–6–0's, the Great Northern 2–4–0's, 4–4–0's and 4–4–2's, the Great Eastern 4–4–0 and 4–6–0 locomotives and the Cambrian 4–4–0 engines. All of which is interesting, but does not affect the fact that opinions differ as to what constitutes a suitable or appropriate system of nomenclature for locomotive engines, and leaves untouched the broad question as to whether it is desirable to name engines at all, in view of their being, after all, merely units in the transportation machinery of the Company to which they belong, sufficiently distinguished for all practical purposes by numbers.

Changes in the Directorate of the Glasgow and South Western Railway.

MR. PATRICK T. CAIRD, chairman, Glasgow and South Western Railway, has resigned his seat on the Board, of which he has been a member since August, 1891. In 1897 he was appointed Deputy-Chairman, and on the retirement in April, 1900, of the late Sir Renny Watson, Mr. Caird was appointed to that post. Mr. Caird is a principal partner in the Greenock shipbuilding firm of Messrs. Caird and Co. Sir James Bell, Bart., Montgreenan, Ayrshire, has been elected Chairman of the Directors in place of Mr. Caird. He was elected a Director of the Company in 1896 and Deputy-Chairman in 1900. He is a former Lord Provost of Glasgow—a post he held for the exceptional period of four years—and principal of the firm of Bell Brothers and Co., steamship owners and exporters. Sir Matthew Arthur, Bart., the new Deputy-Chairman, has served as a Director since October, 1900. He is the principal partner in the firm of Arthur and Co., Ltd., Queen Street, Glasgow. Mr. Charles Ker has been co-opted to the vacancy in the Directorate caused by these changes. He is a member of Messrs. M'Clelland, Ker and Co., 115, St. Vincent Street, Glasgow, chartered accountants, and is a Director of the National Bank of Scotland, the Steel Company of Scotland, and several other important concerns.

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OWING to war conditions it was not thought advisable to hold the annual dinner in connection with the staff of the Chief Goods Manager's department, Lancashire and Yorkshire Railway, Manchester. In place of this the Chief Goods Manager (Mr. H. Marriott) and his staff entertained about 150 Belgian refuges to a dinner and concert, which was held in the head office dining hall, Hunts Bank, Manchester, on Thursday evening, December 17th. Arrangements were made for the refugees to be conveyed to and from their homes in various parts of Manchester to Hunts Bank by motor cars. The party, consisting of men, women and children, sat down to a substantial dinner at 6.30 p.m. This was followed by a concert, programme of which was contributed to by the members of the staff, their friends, and two Belgians. Mr. Marriott (who was supported by Mr. W. A. Marsden, assistant chief goods manager, Mr. W. Slater, deputy-assistant goods manager, and Mr. J. H. H. Bailey, chief assistant), in welcoming the guests, spoke of the close connection of the Lancashire and Yorkshire Railway with Belgium, through their Continental steamship services, and after paying a tribute to the gallantry of the Belgian King and nation, he hoped the day would not be far distant when their return would be possible to a restored and prosperous country. Mr. Marriott delivered the speech in English, and this was afterwards given in both Flemish and French by one of the Company's Antwerp staff. During the evening "Father Christmas" made his appearance laden with toys for the seventy-two children present. The proceedings were brought to a conclusion by the rendering of the National Anthems of the Allies.

* * *

THE Queen's Park extension of the "Bakerloo" section of the London Electric Railway has already been fully described, so that there is no need for further reference in detail to this notable addition to the "tube" railway system of London. Public traffic was inaugurated on Sunday, January 10th, the first train leaving Queen's Park at 7.26 a.m., and the last at 11.43 p.m. The week-day services extend from 5.16 a.m. until 12.43 a.m. From the Elephant and Castle the times of traffic are: Sundays, 7.26 a.m. until 11.52 p.m.; week-days, 5.16 a.m. until 12.52 a.m. The stations at Warwick Avenue and Kilburn Park were brought into use at once, and Maida Vale as soon as possible afterwards. At Queen's Park platform interchange only is for the present provided with the London and North Western and North London suburban trains, but this in itself is a valuable travelling convenience, and is, moreover, only the presage to further developments.

* * *

COMMENCING Monday, January 4th, numerous alterations were made in the Great Eastern Railway timetables. The list, as published in a special booklet, appears a rather formidable one, but on analysis does not prove quite so serious. Hardly any of the more notable improvements made in October revisions are affected. For the most part the alterations embody certain changes already made by special notices, together with retimings in view of factors which have revealed themselves in the light of experience with the new schedules, in combination with other matters due to the conditions which now exist. There are also numerous detail changes in the suburban services. In many cases the alterations now made add considerably to the conveniences already realised.

* * * *

FLASHLIGHT signals have been fixed on the up and down distant signals at Park South Askam station and Green Road, Furness Railway, and after giving them a trial for a period of six months it has been decided to retain the flashlights. These signals are provided by the Gas Accumulator Co. (United Kingdom), Ltd., 2, Norfolk Street, Strand, London, W.C.

* * *

"THE NATURAL HISTORY OF LONDON" is the title adopted by the Underground Electric Railways Co., Ltd., for the Calendar for 1915 issued on behalf of the allied transport undertakings. For several years past the "Underground" calendars have been looked for, on account of their striking character and originality of conception, and the 1915 series of monthly sheets is quite up to the usual standard. Each is embellished with a well-produced natural history picture in colours, the titles being: *January*, Seagulls on the Thames; *February*, Pigeons in the City; *March*, Herons at Richmond Park; *April*, Sheep at Market; *May*, Rabbits of the outer ring; *June*, The Pride of the Thames (Swans); *July*, Brook Dwellers at Home (Voles, etc.); *August*, Peacocks at Kew; *September*, Deer in the Parks; *October*, Woodland Beauties; *November*, The Lover of

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Nuts; *December*, For the Rookeries. To each is appended a note as to suitable localities where the subjects of the pictures may be met with.

* * *

NEW engines of the following classes were placed in service on the Great Western Railway during 1914: 2-6-0 (5 ft. 8 in. wheels), 4-6-0 (4-cylinders), 2-8-0 T and 2-6-2 T (4 ft. 7½ in. wheels). The French locomotive No. 102, *La France*, now carries its original boiler, to which has been added the "Swindon" superheater, whilst No. 103, *President*, is fitted with the standard Swindon No. 1 boiler with "Swindon" superheater and top feed arrangement. Boilers of all Great Western modern engines are now fitted with top feed arrangement. Upwards of 800 engines are in service equipped with superheaters.

* * *

PLATFORM tickets are now required at the following Great Western Railway stations: Birmingham, Moor Street; Birmingham, Snow Hill; Bourne End; Devonport; Falmouth (summer months); Henley-on-Thames; Leamington; Llanelly; Maidenhead; Nelson and Llancaiach; Oakengates; Paignton; Plymouth, Mill Bay; Plymouth, North Road; Shrewsbury; Slough; Taplow; Thame; Torquay; Torre; Uxbridge Vine Street; Westbourne Park; Weston-super-Mare; Witney.

* * *

SLIP carriage services are usually associated with more or less fast facilities; but an innovation on the Lancashire and Yorkshire Railway is of interest in that a slip carriage service is to replace certain calls from a train which, except for its initial run, is a stopping train. This is the 3.20 p.m. (not Saturdays) from Manchester (Victoria). The train takes its Saturday starting time, 3.28 p.m., and instead of calling at Bury, runs through to Ramsbottom, due 3.53 p.m. Thence it calls as heretofore at stations to Baxenden, but instead of stopping at Accrington slips three vehicles there, and these are taken on to serve stations to Rose Grove, while the main train runs fast to Rose Grove, thence continuing as a stopping train to Colne.

* * *

FAST trains are now running regularly on the Paris, Lyons and Mediterranean Railway, from Paris to the Riviera, Switzerland and Italy, leaving Paris at 8.5 p.m. for the Riviera, at 8.15 p.m. for Italy, and at 10.30 p.m. for Switzerland. All these trains are provided with sleeping accommodation. There is no hindrance or risk whatever to be feared on the journey. The Paris, Lyons and Mediterranean Company has issued a list of the principal hotels now open on the Riviera, and point out that some of the habitués have already left for their villas there. British guests are heartily welcome, and although some of the brilliant carnival festivities will not be held this winter, owing to the state of war, entertainments of all sorts will not be lacking.

* * *

REFERRING to the list of London and North Western Railway four-cylinder passenger engines ("Claughton" class) given on page 409 of the November RAILWAY MAGAZINE, the last ten engines, which were recently put into service, are stationed as follows:—Nos. 209 *J. Bruce Ismay*, 856 *E. Tootal Broadhurst*, 2239 *Frederick Baynes*, and 2401 *Lord Kitchener*, at Crewe (15 shed); Nos. 250 *J. A. Bright*, 260 *W. E. Dorrington*, 1131 *Lord Faber*, and 1567 *Charles J. Cropper*, at Carlisle (29 shed); No. 1429 *Colonel Lockwood*, at Camden (1 shed); and No. 668 *Rupert Guinness*, at Edge Hill (26 shed). With the exception of those in the shops, all the engines of the first series are now stationed at Crewe. The five engines of the "Precursor" (4-4-0) type to be altered to superheaters with piston valves, during the half-year ending December 31st last, are: Nos. 106 *Druid*, 366 *Medusa*, 1395 *Harbinger*, 1723 *Scorpion*, and 2513 *Levens*. The first two are stationed at Rugby; the next two at Crewe, and the last one at Edge Hill. No. 631, a 0-8-0 superheater mineral engine, is now running provided with a cab on the tender. One of the "Hound" series of 4-4-0 ("George the Fifth") passenger engines, No. 2495 *Bassethound*, has been fitted with a "Webb" type of regulator; the operating rod passes along the *top* of boiler to the dome, slightly on the right-hand side of engine, and there is the usual lubricator near to the seat of the funnel, as on the "Jumbos" and one or two types of passenger tanks.

* * *

SIR H. A. WALKER, General Manager, London and South Western Railway, in a New Years' message to his staff, expresses his appreciation of the loyal and patriotic manner in which they have carried out the onerous duties they have been called upon to perform since the outbreak of war. In reference to war conditions, he writes, "The requirements of the Admiralty and War Office, in addition to the ordinary business of the company, have necessitated long hours of work, and, in some cases, continuous night and day duty, and it is gratifying to be able to record that such services have been loyally and ungrudgingly performed. Unfortunately the end of our labours in connection with the war is not yet in sight, but I feel sure that I can continue to rely upon the same devotion to duty in the future as in the past."

* * * *

THE retirement of Mr. Charles Harrison, Chief Engineer, North Eastern Railway, is announced. Mr. Harrison has been in the company's service for 48 years, and is a nephew of Mr. T. E. Harrison, who was the company's Engineer of the Northern Division until 1882. He has spent practically his whole business life with the company, and was appointed to the position he is now leaving about 1885. He became Chief Engineer of the Northern Division in 1885, and retained this appointment until 1904, when, on the death of Mr. Cudworth, he became Chief Engineer of the whole railway. He will continue as Consulting Engineer. During his long service Mr. Harrison carried out many important works in connection with the development of the company's system, the most important being the King Edward Bridge over the Tyne, the Queen

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Alexandra Bridge over the River Wear, the extension of the Central station at Newcastle, the direct line from York to Doncaster *viâ* Selby, the Durham coast line between Sunderland and West Hartlepool, and many other important works. He has been for many years a member of the Council of the Institution of Civil Engineers, and a colonel in the Engineer and Railway Staff Corps.

* * *

MR. J. S. TODD, Assoc. M.Inst. C.E., has been appointed District Engineer for the Southern Division of the Great Eastern Railway, taking the position vacated by Mr. Horace Wilmer on his appointment to succeed Mr. Henry Jones as Chief Engineer. Mr. Todd entered the service in 1899 as assistant to Mr. H. Wilmer at Stratford. He has had considerable experience in railway construction, maintenance and renewal of permanent way, bridges, station work, etc., and has generally assisted in the administrative work of the Southern Division, and taken charge of the district in the absence of the District Engineer. Mr. Todd is a "Brunel" medalist of the London School of Economics.

* * *

FURTHER commissioned officers from the Great Western Railway staff are: Second Lieut. T. D. Keyworth, 4th Batt. King's Shropshire Light Infantry (Goods Dept., Wellington, Salop); Flight Sub-Lieut. C. B. Dalison, R.N., Naval Flying Corps (Drawing Office, Loco. and Carriage Dept., Swindon); Second Lieut. R. H. Whitfield, Royal Engineers (Divisional Engineer's Office, Neath); Second Lieut. R. W. Miles, 13th Batt. Sherwood Foresters (General Manager's Office, Paddington); Lieut. C. H. R. Kindersley, 6th Batt. Dorset Regiment (Divisional Superintendent's Office, Bristol); Second Lieut. A. R. Tripe, Royal Garrison Artillery (District Estate Office, Plymouth); Second Lieut. P. Diggory, 9th Batt. The King's Liverpool Regiment (Irish Traffic Manager's Office, Dublin).

* * *

MR. J. RAWSON, Mineral Manager, Midland Railway, has retired from that position, which he has occupied since 1902. He entered Midland service at Kirkstall Forge, and in 1865 went on to Kirkstall in a similar capacity. In 1868 he became chief goods clerk at Wisbech, and in 1871 was promoted to Loughborough in a like position. In 1872 Mr. Rawson was made station agent for the Midland Company at Hitchin, and in 1873 was appointed station master at Rotherham. In 1876 he was made district inspector and canvasser for the Peterborough district, and in 1879 became chief of the ledger collector's department at Birmingham. In 1882 Mr. Rawson became chief of the accounts department in London, until May, 1891, when he was appointed chief canvasser of the goods manager's department. In 1900 Mr. Rawson was appointed chief London (City) representative at the Aldersgate Street offices, with charge of all the canvassing arrangements, etc., and also charge of the Castle and Falcon and Borough depôts. In January, 1902, he succeeded Mr. Joseph Shaw as mineral manager of the Company.

MR. A. W. ALLEN has been appointed Mineral Manager, Midland Railway, in succession to Mr. John Rawson, who has retired under the age limit. Mr. Allen is succeeded as Indoor Assistant to the General Manager by Mr. William Clower.

* * *

THE retirement of Mr. Henry Aldridge, manager of the goods and mineral departments of the Cardiff and Newport districts of the Great Western Railway, completes a record of fifty-two years' railway service. Mr. Elias Ford, who has been chief assistant, succeeds Mr. Aldridge. Mr. J. R. Catherall, superintendent of the goods departments at Newport, succeeds Mr. Ford as assistant goods manager, and Mr. I. J. Anthony, chief clerk to Mr. Aldridge, succeeds Mr. Catherall as goods superintendent at Newport.

* * *

AT the end of last year Mr. S. E. Marsh, Superintendent at Nine Elms Goods station, London and South Western Railway, retired. Mr. Marsh was born at Glastonbury, Somersetshire, in October, 1852, and began his railway career as junior clerk in the goods office of the Somerset and Dorset Railway Company at Glastonbury station in December, 1866. He was removed to Highbridge in August, 1868. In November, 1868, Mr. Marsh went to Nine Elms. Upon the extension of the line to Bournemouth (*via* Ringwood) in March, 1870, Mr. Marsh took charge of the goods department at the station then known as Bournemouth East. In June, 1878, Mr. Marsh was removed from Bournemouth to the assistant goods manager's office at Waterloo, and in the following year was sent to Exeter as district canvasser. Mr. Marsh was then promoted to the position of goods superintendent for the Exeter district. In November, 1897, he was appointed assistant superintendent at Nine Elms, and succeeded the late Mr. H. B. Terrill as goods superintendent upon the latter's retirement two years later.

* * *

To succeed Mr. Marsh as Superintendent at Nine Elms goods depot, Mr. E. H. Turner, Reading district goods superintendent, has been appointed. Entering the service of the Company as a youth, Mr. Turner has been stationed at Reading twenty years. He was placed in charge of the Reading goods department in 1894, and in 1913 was appointed Reading district goods superintendent. The new Reading district goods superintendent will be Mr. H. Spurgeon, Plymouth goods superintendent.

* * *

LIEUT.-COL. F. A. CORTEZ LEIGH, Chief Electrical Engineer of the London and North Western Railway, has been gazetted Lieut.-Colonel in the Royal Engineers, Regular Army, and is in command of the Western Army Troops, Signal Companies, attached to the Royal Engineers at Haynes Park, Bedford. Several railwaymen are under Col. Cortez Leigh's command, including the sons of Mr. E. F. C. Trench, Chief Engineer, and Mr. C. J. Bowen Cooke, Chief Mechanical Engineer, London and North Western Railway.

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We regret to announce the death of Sir Frederick Harrison, a Director of the London and North Western Railway, and since 1909 Deputy-Chairman of the South Eastern Railway, and a member of the South Eastern and Chatham Railway Managing Committee. Sir Frederick Harrison will long be remembered as one of the series of capable general managers who have been responsible for the development of the London and North Western Railway system. He retired from the supreme executive position in January, 1909. A contemporary points out that whereas Mr. H. A. Walker, General Manager, London and South Western Railway, and Chairman of the Railway Executive Committee —himself a former London and North Western officer—has just received the honour of knighthood for services in connection with the present war, his former chief received the same honour for services in connection with the South African War. In addition, Sir Frederick Harrison was one of the Commission sent in 1900 to South Africa to inquire into the care of the sick and wounded during the campaign.

* * *

Mr. J. F. Hewitt, for nearly 32 years the District Locomotive Superintendent of the Somerset and Dorset Joint Railway, stationed at Bath, died there on December 15th, at the age of 72. He had been in failing health for the past twelve months, and not long ago had a serious illness, from which, however, he had partially recovered. Mr. Hewitt served his time in the Midland shops at Derby, his native town. In 1866 he received an appointment in the Midland shops at Peterborough, and ten years later was transferred to Bath, when the Midland and South Western Companies acquired the Somerset and Dorset line. He remained in Bath till he retired in 1907. He was succeeded by Mr. A. H. Whitaker. Mr. Hewitt had control of the Somerset and Dorset repairing shops at Bath, the sheds at Bath and Radstock, and a pumping station at Chilcompton, and was required to attend at all the break-downs on the main line. On his retirement he was able to state that he had never failed to direct the operations of the break-down gang when necessary during his tenure of office. Mr. Hewitt rose from the ranks to the position of Locomotive Superintendent, having commenced as a fitter. He originated several improvements in locomotive and shop equipment; and witnessed the commencement of the "big boiler" *régime* on the Somerset and Dorset line, which dates from 1903, when the three large 4–4–0 passenger engines, Nos. 69 to 71, were delivered.

* * *

We regret to hear of the death, on active service, of Lieut. Arthur George Murray Smith, 2nd Life Guards. He was the eldest son of Mr. George Murray Smith, Chairman of the Midland Railway Company.

* * *

Mr. William James Noble, K.C., of Paper Buildings, Temple, Recorder of Newark since 1893, who died on November 1st, aged fifty-nine years, left unsettled property of the value of £9,974. His will, made in December, 1905, reads: "I leave the whole of my property both real and personal to the Railway Benevolent Institution, an Institution in which my father took great interest, and of which Mr. Mills is the secretary." Probate of the will has been granted to Mr. Alfred Mills, of Euston Square, secretary to the Railway Benevolent Institution. The testator's father, the late Mr. John Noble, of Littleover, Derbyshire, was formerly general manager of the Midland Railway.

* * *

Lord Balfour of Burleigh, K.T., G.C.M.G., Director, Great Northern Railway, has accepted the Presidency of the Railway Benevolent Institution for 1915. The annual dinner will be held on Tuesday, May 4th, at the Whitehall Rooms of the Hotel Métropole. Mr Ammon Beasley, General Manager of the Taff Vale Railway Company, has been appointed Chairman for the year of the Board of Management of the Institution.

* * *

The New Year's number of *Syren and Shipping Illustrated*, always a notable publication, is this year entirely up to usual standard, and includes many items of special interest under present circumstances. In conjunction with a complete review of the shipping year, and of dock and harbour developments, special articles are included dealing with the transportation of Colonial troops to England, and of the services rendered by the merchant marine and by shipping firms. Priced at one shilling, this number is well worthy of perusal and of after preservation for reference purposes.

* * *

The Egyptian Red Crescent Society has presented for the use of the sick and wounded soldiers a fully-equipped hospital train built on the latest and most approved plan. The train has been built on the Egyptian State Railways workshops at a cost of £E.1,600, and will accommodate twelve officers and ninety-six wounded men.

* * *

The Great Western Railway series of handbooks has just been enlarged by the addition of an interesting booklet bearing the title "Yachting in the West." The booklet, which is excellently illustrated, deals with the many snug anchorages along the Devon and Cornish coasts, and describes a sail from Torbay to Penzance. The various beauty spots and landmarks en route are noted, as well as the tides and depths of stream, and such additional information is given as the yachtsman will find useful. Copies may be had, gratis, at the principal stations and offices, or will be forwarded post free upon application to Mr. Chas. Aldington, Superintendent of the Line, Paddington station, W.

* * *

The Accountants' Standing Advisory Committee to the Railway Clearing House have re-elected Mr. C. L. Edwards, Chief Accountant, Great Northern Railway, as Chairman of the Committee for this year.

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In succession to Mr. C. A. Harrison, Mr. Cyril F. Bengough, M.Inst.C.E., Chief Engineer, Southern Division, has been appointed Chief Engineer for the whole of the North Eastern Railway system. Mr. Bengough was born in 1864. He was educated at Marlborough College and University College, Bristol, where he passed through the Engineering Course. In 1885 he became an articled pupil of the late Mr. P. J. Messent, M.Inst.C.E., Engineer to the River Tyne Commissioners, and remained in the service of the Commissioners until 1890. In that year he was appointed Resident Engineer in charge of construction of the Annfield Plain and Team Valley Branches of the North Eastern Railway, under Mr. Chas. A. Harrison. In 1899 he was appointed District Engineer in charge of the Bishop Auckland District. In 1906 he was transferred to Newcastle as District Engineer in charge of the Newcastle District, and in 1909 was appointed Engineer for the Southern Division, with headquarters at York, in succession to the late Mr. W. J. Cudworth. In 1912 Mr. Bengough took charge of the maintenance of the whole of the lines, in addition to the new works on the Southern Division.

* * *

On January 1st the District Railway added a special Harrow-City express, known as "The Harrovian," leaving South Harrow at 8.15 a.m., and calling only at Sudbury Hill, Sudbury Town, Alperton, North Ealing, Chiswick Park and Hammersmith to Sloane Square, and reaching Mansion House at 8.54 a.m., a distance of 15 miles 21 chains, in 39 minutes inclusive.

* * *

Owing to a combination of circumstances the photograph reproduced on page 1 of the January Railway Magazine showing the 9.50 a.m. Highland Railway mail train leaving Inverness for Wick and Thurso, was attributed incorrectly. It was taken by Mr. D. Matheson, of Inverness.

* * *

Classes on railway subjects have been arranged by the London County Council at the Commercial Evening Institute, Maida Hill, on "Railway Station Accounts and Traffic Administration," by Mr. J. A. Jenkinson, and "Railway Law," by Mr. T. O. Newman, LL.B., London.

* * *

The Barry Docks and Railway Company have secured a large area of land adjoining the docks, eminently suitable for sites for the establishment of works and factories.

* * *

In the New Year's Honours a baronetcy of the United Kingdom was conferred on Col. Robert Williams, M.P., Chairman of the Public Accounts Committee and a Director of the London and South Western Railway.

* * *

According to the *Central Argentine Railway Magazine*, 150 of the Company's men left the Argentine to join the Colours on October 9th.

Railway Literature.

Records of Railway Interests in the War. Price One Shilling. [Post free, from the offices of the Railway Magazine, 30, Fetter Lane, E.C., 1s. 1d.]. This volume has been prepared by our contemporary, the *Railway News*, and collects in convenient form many contributions of current interest published in its pages since the outbreak of war, together with other information of a like character. With pages the same size as the usual weekly issues, there is scope for favourable presentment of the numerous illustrations included, and as the volume is printed on art paper the result is most effective. The contents include a chronology of the early days of the war; portraits of all members of the Railway Executive Committee; a collection of official and Parliamentary notices and statements concerning the relations between the Government and the railway companies, together with information in reference to the Act under which the railways are now being administered under State direction; the Engineer and Railway Staff Corps; particulars of the arrangements for the departure of the German, Austrian and Turkish Ambassadors from the United Kingdom; the mobilisation and movement of troops; goods and coaching traffic notices; railway companies' steamers and docks and the war; other railway work for the State; railwaymen with the colours; provision for men and their families; and other usual data. Fully illustrated descriptions are then given of the railway companies' ambulance trains, vans and hospital ships; and the volume concludes with a reference to first aid and ambulance work on railways, and special rolling stock suited to the conveyance of war material. The result is a very fine collection of material, which should be of great value for record in the future, as well as possessing present interest.

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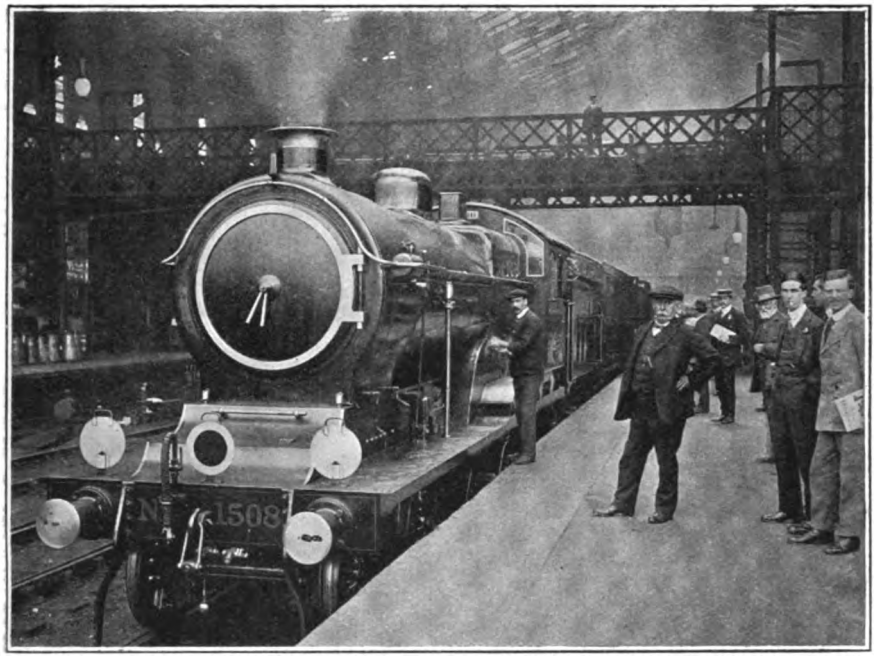

SPECIAL TRAIN AT LIVERPOOL STREET.
Drawn by 4-6-0 superheater locomotive No. 1508.

The Great Eastern Railway of To-day.

By J. F. GAIRNS.

TAKING third place among British railways in respect of total numbers of passengers conveyed annually* and fifth in England as regards length of line, the Great Eastern Railway of to-day ranks in every sense as one of the "great" systems of the United Kingdom. It has long since outlived the somewhat unsatisfactory reputations of the Eastern Counties and earlier Great Eastern companies, and is now considered as a well-conducted business-like railway of good financial standing. Its traffic is steady and comprehensive, with few distinctive features, though including in considerable volume nearly every class of traffic which in other cases calls for special comment.

Outstanding features are the London suburban traffic, and the agricultural traffic associated with the East Anglian counties. But while one can hardly emphasise other branches of activity as peculiarly characteristic, the Great Eastern Railway ranks among the leading "holiday" and "business" lines, and is important in respect of coal, industrial, fish and other classes of traffic. The Great Eastern Railway also ranks as one of the leading Continental traffic lines, its steamers running between Parkeston Quay, Harwich, and the Hook of Holland ("British Royal Mail Route"), and to and from Antwerp. Other company's steamers run to and from Hamburg, Esbjerg, and during the summer months to and from Gothenburg. The company is also owner of first-class hotels and up-to-date harbours and docks.

There is no need here to review Great Eastern Railway history and development. For that readers may be referred to an "Illustrated Interview" with Lord Claud Hamilton—who has just attained his "majority" as a railway chairman by completing 21 years' service as Chairman of the Board of Directors of the Great Eastern Railway Company—published in the RAILWAY MAGAZINE for December, 1898, and to numerous articles reproduced in later issues. It will be sufficient to deal with the Great Eastern Railway as it is to-day, and with its present traffic, material, and methods.

* For some years the Great Eastern held first place, but growth of Great Western traffic, and the addition of London, Tilbury and Southend passengers to the Midland totals, brought these lines above the Great Eastern in 1913.

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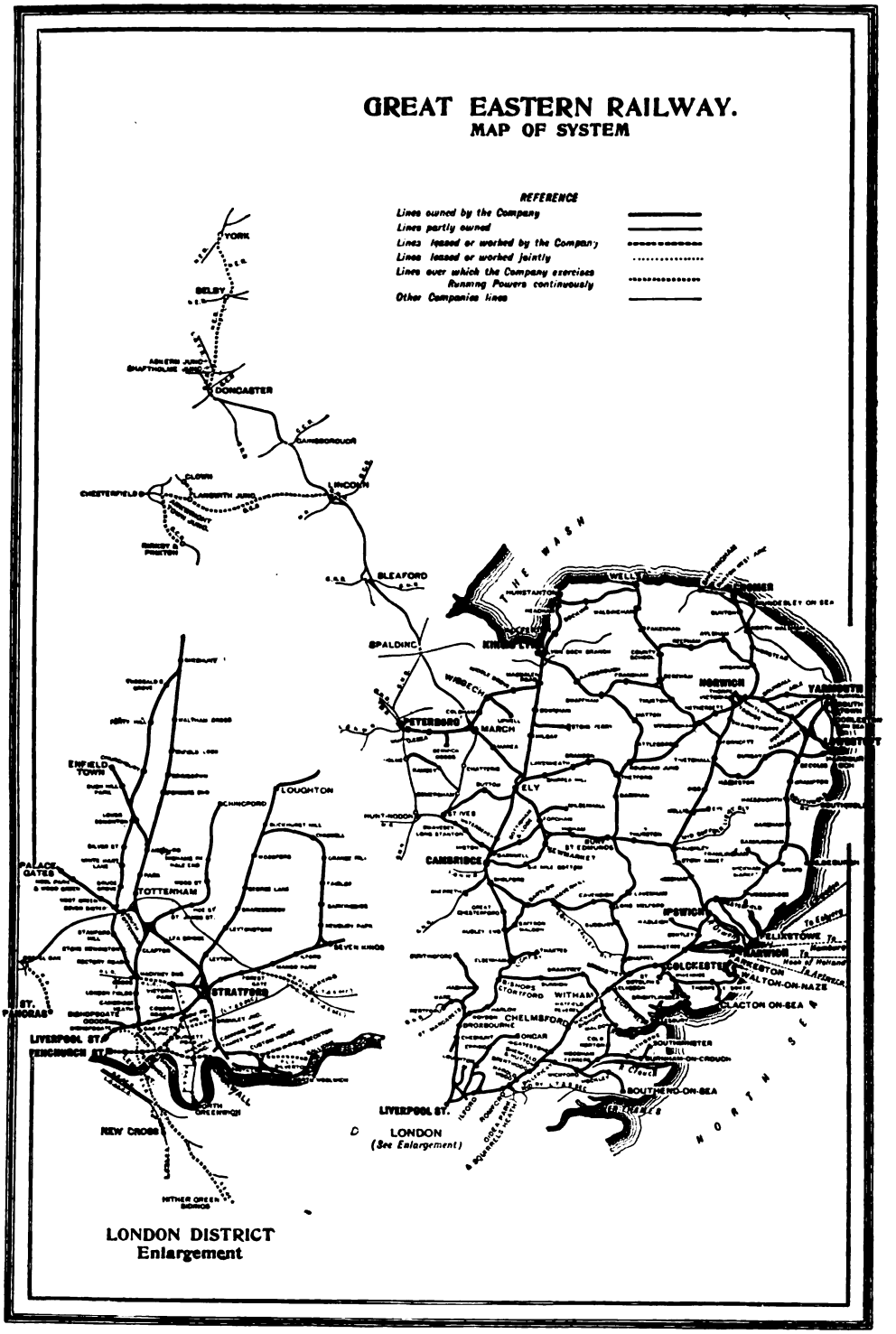

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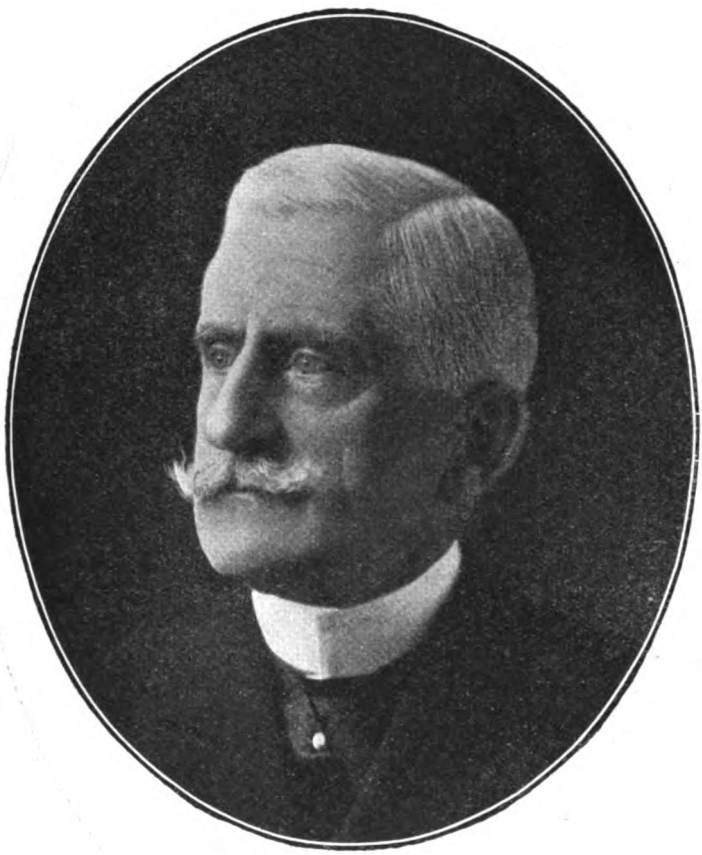
Except for a degree of competition with the Great Northern, North London and Whitechapel and Bow lines in North and East London, with the Great Northern in certain other districts, with the London, Tilbury and Southend section of the Midland Railway in South-East Essex, and with the Midland and Great Northern joint lines in the Norfolk district, the Great Eastern is essentially *the* East Anglian Railway, providing Essex, Suffolk, Norfolk and the East Anglian border counties — Hertfordshire, Cambridgeshire and Huntingdonshire, with a portion of Lincolnshire—with a network of lines together constituting a notably comprehensive inter-communication system. Except, perhaps, to Southend and Cambridge, and to a slight extent to Cromer and neighbouring resorts, such competition as there is can hardly be described as serious as regards the Metropolis; but it counts for more in respect of cross-country communication with other portions of England, though even in that respect the Great Eastern holds the advantage to a considerable extent. Otherwise, except for places which are served by branch lines, but are themselves located on the Great Northern main routes, such as Peterborough and Huntingdon, the Liverpool Street management is responsible for by far the larger portion of the railway transportation of East Anglia.



Photo] [*Kate Pragnall.*

LORD CLAUD HAMILTON, M.P.

Chairman: Great Eastern Railway Company.

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MR. HENRY WORTH THORNTON,
General Manager, Great Eastern Railway.

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TABLE I.

Capital issued by—	
Loans and Debenture Stock	£18,353,116
Preference Stock	£20,826,335
Ordinary Stock	£15,362,886
*Gross Receipts—	
Railway	£6,015,142
Passenger Road Vehicles	5,618
Steamboats	376,604
Canals	1,230
Docks, Harbours and Wharves	36,023
Hotels, Restaurant Cars and Refreshment Rooms	278,518
	£6,713,135
*Expenditure—	
Railway	£4,082,732
Passenger Road Vehicles	7,734
Steamboats	326,493
Canals	952
Docks, Harbours and Wharves	24,834
Hotels, Refreshment Rooms and Restaurant Cars	222,325
	£4,665,070
Net Receipts	£2,048,065
Miscellaneous Receipts	125,265
Total Net Receipts	2,173,330
*Gross Receipts (Railway)—	
Passenger Train Traffic	£3,239,036
Goods Train Traffic	2,703,173
Joint Lines	6,627
Miscellaneous	66,306
	£6,015,142

Yet, while having so large an area almost to itself, Great Eastern services are systematically good and comprehensive, especially since the complete revision of the time tables recently carried out. As a holiday line the Great Eastern Railway serves a remarkable series of coast resorts. Twenty are claimed by the Company, but a few more could be added by including smaller and neighbouring places of interest. But in Southend, Clacton-on-Sea, Frinton-on-Sea, Walton-on-the-Naze, Harwich, Dovercourt Bay, Felixstowe, Aldeburgh, Southwold (*viâ* the Southwold Railway), Lowestoft, Corton, Gorleston, Yarmouth, Cromer, West Runton, Mundesley, Trimingham, Overstrand, Sheringham, and Hunstanton, a very presentable series is provided, distributed along the coast-line from the Thames to The Wash, and supplying sufficient variety to suit nearly all requirements. Moreover, to many of these the Great Eastern Railway provides the only route from London, and in other cases the most direct and convenient routes.

* These statistics relate to 1913, corresponding figures for 1914 not being given owing to the special conditions under which the railways are working.

There may not be the rugged coast to be found in the west, south-west, and north-east of England, or the chalk cliffs of the south, but the East Anglian coast has its own special attributes, with bracing air, beautiful sands and attractions such as are not to be found elsewhere to the same degree.

Inland, too, the Great Eastern Railway serves country much of which is entirely unlike that found anywhere else. "The Broads," for example, possess a character and attributes which are peculiarly their own. The "Fen" country is suggestive more of the "Low Countries" than of England; while much of East Anglia other than these special districts has its own particular characteristics. In addition, the Great Eastern Railway gives access to many towns and centres of special interest, such as Ipswich, Cambridge, Ely, Bury St. Edmunds and Norwich; and as the "Cathedral Route" to York, Great Eastern facilities appeal strongly to those interested in ecclesiastical matters, associated as they are so largely with historical and antiquarian research and travel.

Industrially the Great Eastern Railway is concerned primarily with agriculture, in connection with which a number of special facilities are in force; but apart from their holiday character, Yarmouth and Lowestoft are important in this respect also, and both Ipswich and Norwich are great manufacturing and trading centres. In addition, a large number of other towns—Chelmsford, Colchester, Stowmarket, Kings Lynn, Harwich, Thetford, Dereham, Beccles, Tivetshall, Sudbury, etc.—are centres of industry on a smaller scale, while in the case of Spalding, Sleaford, Lincoln, Gainsborough and Peterborough the Great Eastern Railway caters for a considerable volume of industrial traffic.

In respect of coal, the company takes rank among the great coal-carrying lines, inferior only to those which actually serve colliery districts, the nearest of which involves the use of other companies' lines before traffic can reach the Great Eastern system. But in order to supply the coal requirements of East Anglia, and largely also the eastern and southern districts of London, together with a considerable proportion of that required by the southern counties, a very large tonnage passes annually *viâ* Doncaster and Lincoln over the Great Northern and Great Northern Joint Line, also *viâ* Peterborough, from the Great Northern, Midland, and London and North Western systems. In

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MR. POWIS LOMAS
Secretary.

MR. A. E. DOLDEN.
Accountant.

MR. WM. C. MAY.
Chief Traffic Manager.

Photo] [*Elliott & Fry.*

MR. A. J. HILL.
Locomotive, Carriage and Wagon Superintendent.

MR. H. WILMER
Chief Engineer.

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fact, while Great Eastern locomotives proceed beyond the limits of East Anglia only to York for passenger traffic, they run through for mineral traffic over a considerable portion of the Great Central system in the Nottingham and Derbyshire coalfields, gathering coal at numerous collieries situated on that company's lines.

As a Continental traffic line the Great Eastern Railway now takes a leading place, and as the "British Royal Mail Route" the Harwich services count for a great deal. This applies not only in reference to London, whence the facilities provided are, in normal times, the most convenient for many parts of Northern Europe, as well as for places in Holland and Belgium, but also as regards other portions of Great Britain, the special boat train from York, and through carriages from Liverpool, Manchester, Sheffield and Birmingham, conveying a considerable volume of traffic, while on the goods side the traffic is similarly comprehensive.

It will, of course, be understood that we are speaking of normal and standard facilities, and it is unnecessary to emphasise the temporary changes and suspensions incidental to the outbreak of war.

In reference to suburban traffic the Great Eastern Railway is one of the most important lines serving London, and ranks on level or even superior terms with the London and South Western and one or two other systems which are noted for the volume and comprehensiveness of their residential traffic. In fact, it is mainly this work which places the Great Eastern third in respect of total numbers of passengers carried annually, the record for 1913 of 97,172,646 (excluding season-ticket holders) being exceeded only by the Great Western and Midland Companies, while in respect of season-ticket holders the Great Eastern total of 61,924 is only beaten by the Midland Company's 64,335. When it is remembered that on the basis of total mileage four companies in England and one in Scotland exceed the Great Eastern, this fact is notable, especially as there is only one large town—London—to account for these large figures, while several other companies have at least one or two big industrial towns to bring up their passenger traffic and season-ticket statistics.

Other notable features of Great Eastern traffic are the fish landed at Lowestoft and Yarmouth for transit by rail to London and other centres, and the racing and training stable traffic to and from Newmarket, with, on a smaller scale, the sea-water traffic from Lowestoft to London, the farm and market garden produce facilities which apply over many districts, and certain other special arrangements, some of them peculiarly Great Eastern.

Several tables are included summarising some of the detailed statistics rendered accessible by the latest available annual reports, wherefrom the new system of preparing the accounts and returns enables much material of interest to be extracted. Table I. deals with the financial aspects, Table II. with statistical items, and Table III. with traffic data. These facts may, however, be allowed to speak for themselves without further reference.

TABLE II.

	Miles.	Chains.
Mileage owned	1,107	23
Share of joint lines	74	68
Share of lines	8	9
Share of lines leased or worked jointly	—	75
Total mileage (1st track)	1,191	15
" " (2nd ")	686	53½
" " (3rd ")	39	63½
" " (4th ")	31	35
Over four tracks	18	7
Total length of single track	2,621	15
*Mileage over which running powers are exercised continuously	108	50
*Mileage over which running powers are exercised occasionally	386	49
*Running lines maintained	1,959¼	—
*Sidings maintained	694¼	—
Rolling Stock—		
Tender engines 0-6-0	417	
" " 2-4-0	110	
" " 4-4-0	171	
" " 4-6-0	34	
Tank engines 0-4-0	15	
" " 0-4-4	40	
" " 0-6-0	262	
" " 2-4-2	236	
" " 0-6-2	2	
Carriages (uniform class)	3,228	
" (composite)	819	
Restaurant cars	52	
Other coaching vehicles	1,717	
Open wagons	19,034	
Covered wagons	4,713	
Special wagons	1	
Cattle trucks	1,710	
Rail and timber trucks	943	
Goods brake vans	676	
Service vehicles	2,847	
Steamers (over 250 tons net)	11	
(under 250 tons net)	2	
Motor boats	3	
Motor road vehicles	5	
Horse omnibuses	27	
Carts and wagons	1,337	

* These are necessarily 1913 statistics.

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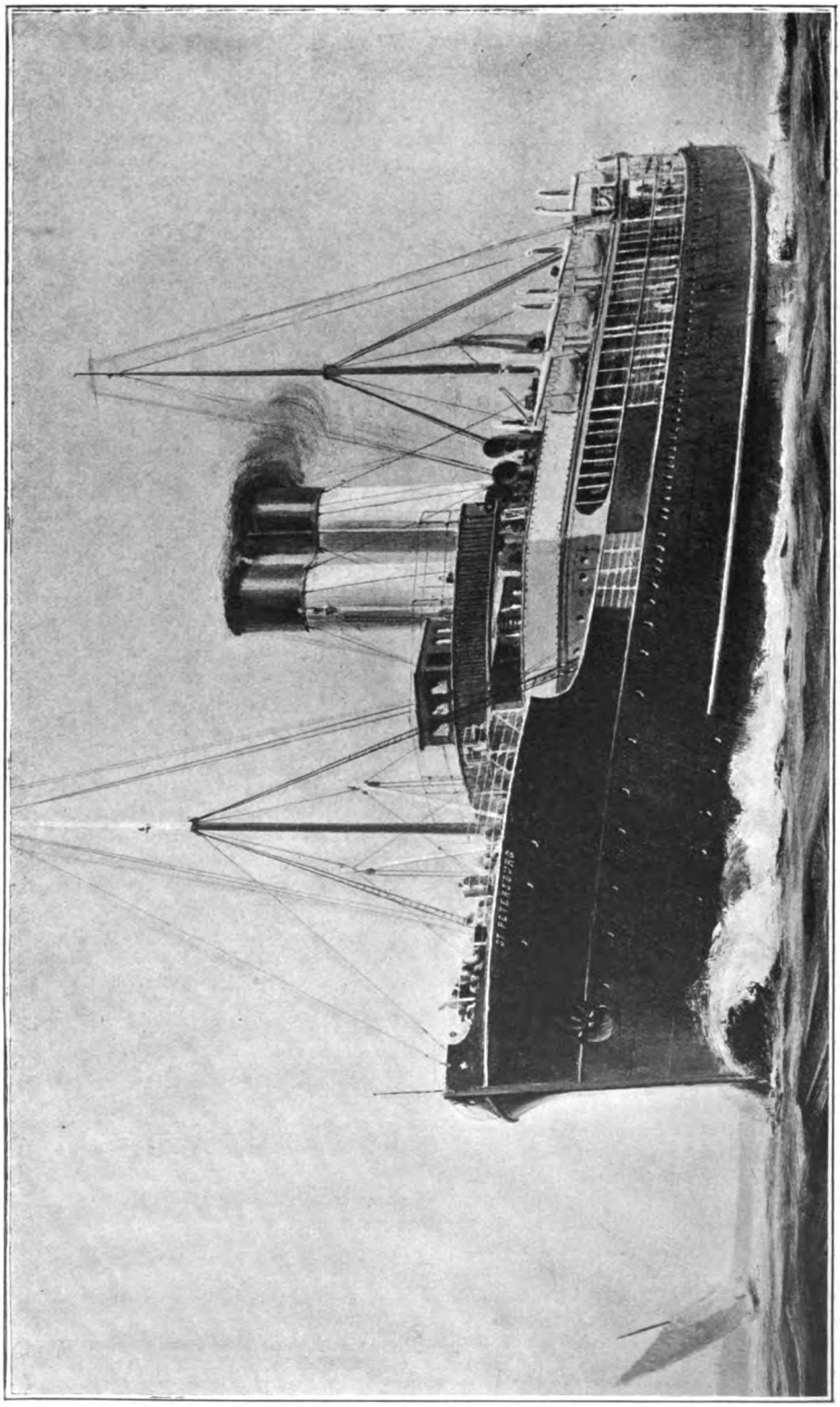

CONTINENTAL MAIL STEAMER, *St. Petersburg*.

343 ft. long, 45 ft. broad; gross tonnage, 2,500; Turbine engines, indicated horse-power, 10,197.

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Multiple-Track Sections.

A special feature of the Great Eastern system is the extent of multiple-tracking involved in the London area. Out of Liverpool Street the 18 platforms—none too many now, though when the East Side section was added in 1893 it was thought that there would be sufficient accommodation for a very long period ahead—lead into six tracks known as "Suburban," "Local," and "Fast." Beyond Bishopsgate the connection to the East London is put off—now only used for goods trains to the London, Brighton and South Coast and South Eastern and Chatham Railways, with a few specials—and at Bethnal Green the six lines become two sets of four, one towards Hackney Downs and the other towards Stratford. The latter is joined on the "Through" section by the high level lines serving Spitalfields goods station, where, in addition to large accommodation for general goods traffic, there is a branch to the Whitechapel hoist. This will transfer two trucks (35 tons) at once from the Great Eastern Railway viaduct to the East London Railway sidings, 46 ft. below. Towards Stratford the "Through" lines have no platforms at Bethnal Green, Globe Road and Coborn Road stations. Near Globe Road there is a large street-level yard reached by an incline between the two sets of running lines, thence passing below the "Local" tracks, while on the "Through" side is a coal yard and another extensive goods yard with transhipping facilities along the Regent's Canal.

At Bow Junction the Fenchurch Street lines come alongside—the Fenchurch Street section is four-track between the terminus and Stepney station, and three-track between Burdett Road and Gas Factory Junction, but only two track otherwise—and to Stratford Western Junction there are six lines—"Local," "Through," and "Fenchurch." The last of these later becomes the Woolwich section, diverging to Stratford Market, but before it does so is connected with both "Through" and "Local" lines towards Stratford. On this section there is, on the down side, the Midland Company's Bow goods, coal and oil depot, and Messrs. Bryant & May's factory with a special goods line and platform, and on the up side several goods lines serving various factories along the banks of the River Lea and other waterways here.

At Stratford the Colchester line is four-track, with a platform loop to the up through line through the station, and continues as a four-track main line to Romford station, the nearer intermediate stations not having platforms on the through lines. Towards the Cambridge route there are three passenger lines through Stratford and two goods lines as far as Temple Mills, with relief goods loops, permissively worked, for some distance beyond. Remaining four-track sections are from Stratford Market to Thames Wharf Junction. The Hackney Downs route is four-track only from Bethnal Green to Hackney Downs station, without platforms intermediately on the "Through" lines.

Further afield the Great Eastern has no need for multiple tracking beyond the provision of relief and goods line in the Ipswich, Norwich and Cambridge districts, but nearly every station has a complete equipment of goods accommodation, so many of them being centres for general agricultural traffic.

Special Features of Traffic.

There are, however, a number of stations which do call for special provision, such as Stowmarket for explosives traffic, Histon for jam, and fruit traffic involved thereby, Manningtree for xylonite, Enfield for the Government small-arms factories, and Waltham Cross and Hadham for cordite. On a larger scale, the fish and harbour traffic at Lowestoft, where the harbour belongs to the Great Eastern Railway, and the river, shipping and fishing traffic at Yarmouth, call for special accommodation. In the former case there are lines into the fish market and harbour, with other facilities, as recently set forth in these pages by another

Table III. *

Number of passengers	1st class	1,849,548	
	2nd ,,	2,103,005	
	3rd ,,	65,570,111	
	workmen	27,949,982	
	total	97,172,646	
Season tickets		61,924	
Classes of traffic conveyed—			
Bricks		287,570	tons
Cement		119,873	,,
Grain		1,088,275	,,
Hay and Straw		133,518	,,
Stone		507,785	,,
Vegetables		361,706	,,
Total merchandise traffic ..		5,717,841	,,
,, coal, coke and patent fuel		5,078,840	,,
,, other minerals		2,436,226	,,
,, goods and mineral tonnage		13,232,907	,,
Number of live stock		1,790,329	
Total engine miles		31,195,583	

* Necessarily on the basis of 1913 statistics.

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writer, while at Yarmouth the railway tracks are continued through the streets, involving the use of special locomotives, to reach the quays, the fish market, the timber yards and some of the riverside works. Ipswich and Norwich are, of course, important manufacturing centres, with accommodation accordingly, and the company has recently commenced the construction of additional lines at the former town to improve connections with riverside works and yards. In the Wisbech district the fruit traffic is an important factor, and in Cambridgeshire the fruit-preserving industry is a considerable one. The silk traffic of Maldon, Halstead, and Braintree also requires mention.

As regards other places, it will be sufficient to mention the boat-building industry at Brightlingsea and Burnham-on-Crouch, the Felixstowe Docks, the harbour and docks at King's Lynn, yacht building at Wroxham and certain other centres in the Broads district, the special accommodation for horse-racing and associated traffic at Newmarket, and, last but by no means least, the Company's elaborate equipment for dealing with Continental traffic at Parkeston Quay, and the associated importance of Harwich, further developed since that place has become a naval centre.

The London Lines.

In many ways the London sections of the Great Eastern Railway are peculiarly interesting. There is, in fact, a network of lines, but for passenger traffic no attempt is made to work them on that basis, but rather as a series of more or less distinct routes, intermixed only in so far as they are necessarily associated. This policy of separation of routes is, indeed, carried so far as to affect track selection on the four or six-track sections, and is largely the secret of the effective way in which suburban traffic is operated at busy periods. For goods traffic, however, there is a serious complication of routes, further influenced by the running powers exercised on particular sections by the Midland, Great Northern, London and North Western and North London Railways.

Completion of the works to be undertaken by the Midland Company between Stepney and Gas Factory Junction, on the old Blackwall Extension Railway, will do much to overcome the serious congestion of the Fenchurch Street line. Here, in addition to the running of Midland (London, Tilbury and Southend section) trains—a very considerable factor in the traffic of the Blackwall

Photo] [*Albert Hester.*

A SUMMER SATURDAY MORNING AT LIVERPOOL STREET.

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and Blackwall Extension lines, though, on the former, four-tracking has relieved the situation to some extent, except that the limited capacity of Fenchurch Street station is a great drawback—there are Midland goods trains to the docks *viâ* Limehouse Curve, to Royal Mint Street depot and to the Commercial Road depot built by the Tilbury Company, Great Northern goods trains from Bow and the North London Railway to Royal Mint Street depot, and North London and London and North Western goods trains to Haydon Square depot, besides Great Eastern goods trains to Park and Stratford Low Level, to the docks in the one case and to the Canning Town depot and Stratford Market in the other; and North London goods trains from Victoria Park to Temple Mills for London and North Western interchange traffic.

The Suburban Routes.

Great Eastern suburban traffic may be classified as—

(1) Liverpool Street to Colchester line *viâ* Stratford.
(2) Liverpool Street to Loughton line *viâ* Stratford.

Photo] [*Albert Hester.*

NAVAL TRAFFIC AT LIVERPOOL STREET.

the Poplar and Millwall Docks, to the London Docks and to the Minories warehouse.

On this section, however, foreign traffic is largely kept away from the Liverpool Street route, only Midland goods trains passing through Stratford; but the main line is affected also by Midland goods trains between their Bow depot and the connections north of Temple Mills and Lea Bridge with the Tottenham and Hampstead line, while on the Woolwich route there are Midland goods trains *viâ* Temple Mills, travelling over the loops in the Stratford district; Great Northern and London and North Western goods trains *viâ* Victoria

(3) Fenchurch Street to Colchester line *viâ* Stratford.
(4) Fenchurch Street to Loughton line *viâ* Stratford.
(5) Liverpool Street to Woolwich line *via* Stratford Market.
(6) Fenchurch Street to Woolwich line *viâ* Stratford Market.
(7) Fenchurch Street to Woolwich line *viâ* Bromley.
(8) Fenchurch Street to Blackwall line.
(9) Liverpool Street to Chingford line *viâ* Hackney Downs.
(10) Liverpool Street to Enfield Town and Palace Gates *viâ* Hackney Downs.

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NORWICH (THORPE) STATION.

(11) Liverpool Street to Cambridge line *viâ* Hackney Downs.
(12) Liverpool Street to Cambridge line *viâ* Stratford.
(13) Victoria Park to Canning Town *via* Stratford Low Level.
(14) Palace Gates and Woolwich *viâ* Lea Bridge and Stratford Low Level.

No. 12 now consists of very few through trains, being mainly supplied by locals from Stratford which do not conflict with other trains except as regards their access to and from the carriage sidings for terminal work. The old Stratford-Chingford services have now been discontinued, so that one complicating factor is removed.

In itself this makes a comprehensive list, especially when it is remembered that No. 1 includes not only trains for the Ilford stations, but also the Barking trains, outer suburban facilities affecting Chadwell Heath, Romford and stations to Chelmsford, and the residential trains serving Southend, Clacton-on-Sea, and other more distant places now in favour for season-ticket traffic. But except for the crossing-over essential to Fenchurch Street traffic to and from the Colchester and Loughton lines—both in effect a double one, and in one stage for the latter—all these routes are kept very much distinct by choice of tracks on the multiple sections.

By Courtesy] [*W. H Smith & Sons, Ltd.*

CAMBRIDGE STATION.

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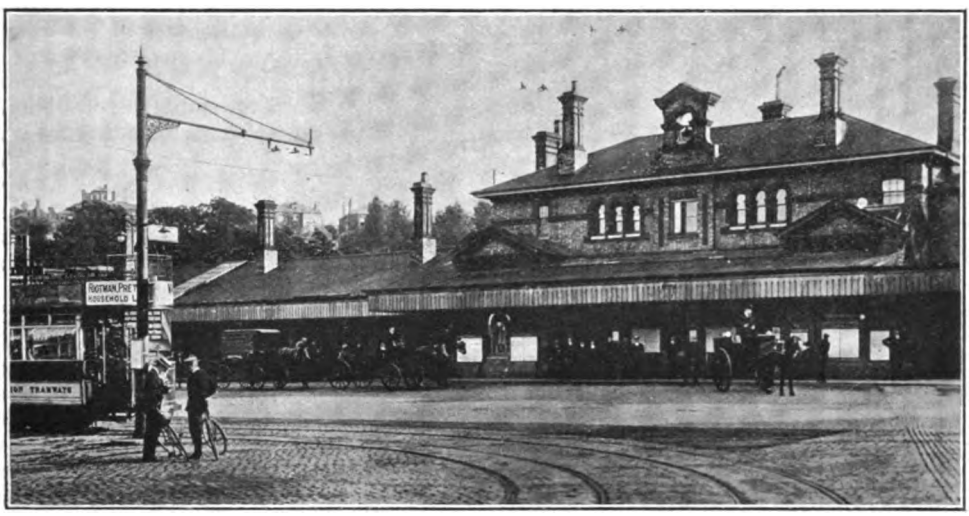
Thus, at Liverpool Street the Chingford and Enfield routes are served mainly from platforms Nos. 1-4, and the "Suburban lines," with a few fasts—a selection of these run from platforms 5-8, but not enough to affect the main principle—over the "Local" lines and thence *viâ* the "Through" lines from Bethnal Green to Hackney Downs. Some of the early morning special "up" workmen's trains from Lower Edmonton travel *viâ* Tottenham (Hale) and Stratford, but these are quite exceptional. A few of the Cambridge line locals also use platforms 1-4 and the "Suburban" lines, and others platforms 5-9 and the "Local" lines, following the same system of classification.

Loughton line trains—platforms 4-8, and



By courtesy] [*W. H. Smith & Sons, Ltd.*

IPSWICH STATION.

usually 5 or 6—are mostly run over the "Local" lines in the centre. Main line traffic is operated to and from the "Through" lines, except that for the Cambridge route the "Local" tracks are largely used for convenience. Almost the whole of the Colchester route traffic—platforms 7-18—passes over the "Through" lines, whether fast or slow, long-distance or local. At Bethnal Green the crossover connections there enable such trains as are not already on the most suitable lines to be further sorted out, those *viâ* Hackney Downs necessarily diverging here along one four-track section, while towards Stratford almost all the fast trains for the Loughton route use the "Local" lines, the few exceptions being transferred thereto at Bow Junction, so that it is only Woolwich and slow Ilford trains which are mixed therewith, the "Through" lines taking not only the expresses, but also the fast suburban trains towards Ilford and all the goods trains to and from Spitalfields goods station and the Devonshire Street coal and goods depots in connection near Globe Road station.

At Bow Junction there may be a further sorting out or a crossing-over to avoid empties and goods trains nearer Stratford, but the general result of the methods thus adopted is that trains are routed so as to avoid as far as possible clashing with others, the selection of "Suburban," "Local," or "Through" lines out of Liverpool Street, "Through" or "Local" lines from Bethnal Green to Hackney Downs or to Bow Junction; "Local," "Through," and "Fenchurch" lines from Bow Junction to Stratford Western Junction; and "Local" or "Through" lines along the Colchester route, being governed entirely with a view to convenient traffic working, with very little reference to whether a train is fast or slow, suburban or long-distance, passenger or goods, empty or loaded.

Goods Facilities in the London Area.

As already indicated, the principal complications relate to the goods traffic. The chief sorting sidings in London are at Temple Mills, about a mile beyond Stratford towards

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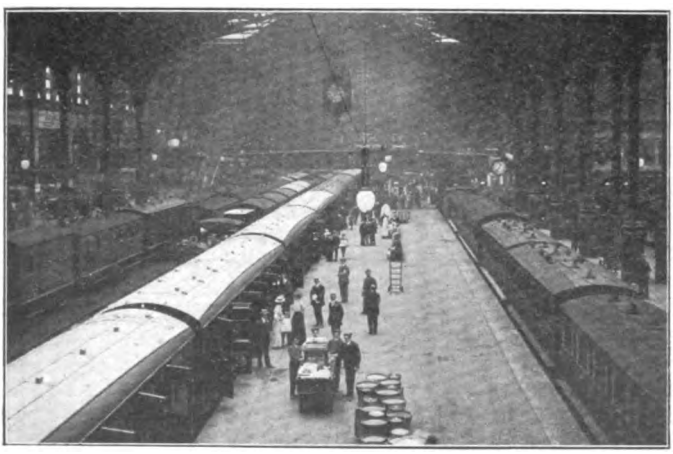
PLATFORMS 3, 4 AND 5, FROM THE CIRCULATING AREA.

NO. 9 PLATFORM, FROM THE CIRCULATING AREA.



ANOTHER VIEW OF NO. 9 PLATFORM.

Interior Views at Liverpool Street Station.

Lea Bridge and the Cambridge main line, this location being particluarly convenient owing to its being placed on reclaimed marsh land and therefore free of building complications, while they are principally served from the Cambridge line, over which the larger proportion of the goods traffic is worked, and where the passenger traffic is not so extensive as on the Colchester route. North of the sidings access is had to the Cambridge main line at Tottenham (Hale), with triangular connections to the Hackney Downs and Chingford routes and to the Tottenham and Hampstead lines, the latter leading to the Tufnell Park depot of the Great Eastern Company, and providing the usual route for Midland goods trains to reach the Great Eastern London lines.

South of Temple Mills there are extensive goods yards and carriage sidings, aggregating about 16 lines abreast near Loughton Branch Junction. Then by means of the Chobham Farm loop, which immediately divides into inner and outer goods lines, access is had to the line through Stratford Low Level to Stratford Market and the docks on the Woolwich line. The inner of these routes passes between the engine sheds and the main carriage sidings, and gives access only to the Low Level station, but the outer route, skirting the engine sheds, makes a longer sweep, joining the Victoria Park line by a triangular junction, and then curves round to serve either the Victoria Park—Stratford Low Level lines or to

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continue through the southern carriage sidings so as to join the main lines to the south of Stratford Main station.

Now that the Stratford-Chingford trains are discontinued, the only regular passenger trains traversing these curves are those between Palace Gates and Woolwich, and these usually take the outer route. Special trains, such as the half-day excursions from St. Pancras to Clacton-on-Sea, run this way to obtain access to the Colchester main line, as also the Bank Holiday trains from Chingford to Clacton-on-Sea *viâ* Lea Bridge, Stratford and the Loughton branch, the latter involving virtually a connection with their former route in the reverse direction before diverging to Leyton.

As a rule, only special through goods trains and complete loads are worked intact past Temple Mills to or from Spitalfields or Devonshire Street goods depots, or on the various dock routes, the usual practice being that collecting or distributing trains are worked between Temple Mills and the particular local depots and routes. Colchester line goods trains are, therefore, the only main line ones — apart from through trains which pass Temple Mills and certain special trains—which go through Stratford. There is, however, a constant succession of local goods trains through Stratford in all directions, and it is impossible to keep them entirely clear of passenger traffic even during the busiest hours.

On the down side of the Loughton section there are through goods lines—also used largely by empties—but on the main line side of Stratford station most goods trains take the "through" lines for some distance, the local depot at Stratford, together with those at Forest Gate Junction and near Ilford, being on that side. A steeply graded loop from the main lines at Stratford enables Colchester line trains to pass direct to the Woolwich branch. The latter serves the Victoria and Royal Albert Docks, with a branch to Beckton Gas Works on which irregular passenger trains are operated at varying hours to suit the working times of the men employed there. From Stratford Market station to Thames Wharf Junction there are additional goods lines to cope with the enormous traffic which passes over this section to the docks and the Stratford Market depot of the Company—one of the principal centres for coal, vegetable and other traffic in this district—and other depots. Beyond Thames Wharf Junction the goods lines are virtually continued in the docks area, though they are then under the Port of London Authority, as is also the passenger branch from Custom House to Gallions (Royal Albert Docks). At Silvertown and North Woolwich the Great Eastern Railway serves a busy industrial area, many large manufacturing establishments being located here.

Suburban Passenger Traffic.

Of the London routes, the Enfield Town, Lower Edmonton, Palace Gates, Walthamstow and Chingford services are primarily of passenger importance, and based very

LIVERPOOL STREET STATION AND GENERAL OFFICES, SHOWING APPROACHES TO MAIN LINE AND WEST SIDE SUBURBAN BOOKING OFFICES.

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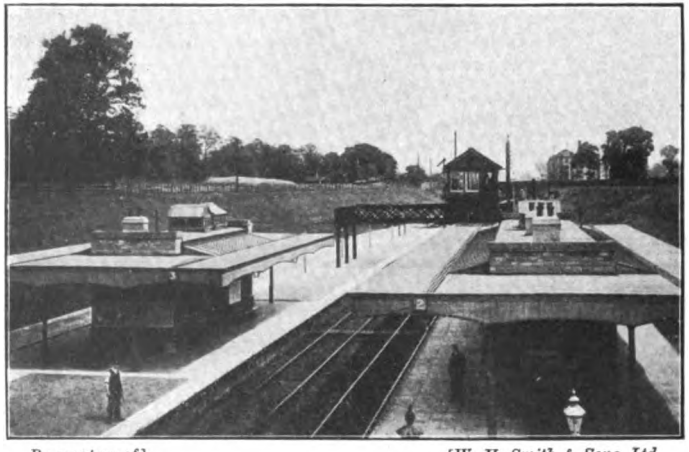

By courtesy of] [*W. H. Smith & Sons, Ltd.*

GIDEA PARK AND SQUIRRELS HEATH.

By courtesy of] [*W. H. Smith & Sons, Ltd.*

LEYTONSTONE.

Photo] [*A. Hester.*

HACKNEY DOWNS.

By courtesy of] [*W. H. Smith & Sons, Ltd.*

CHINGFORD.

Examples of Great Eastern Railway Suburban Stations.

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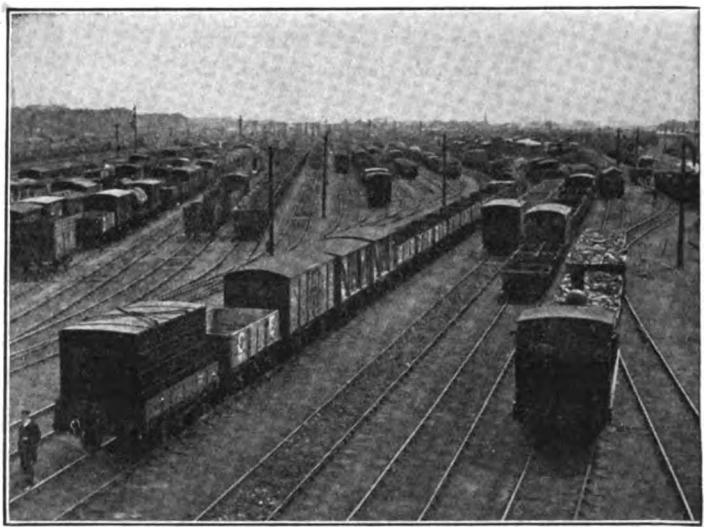
largely upon the peculiar and exceptional development of workmen's traffic in Great Eastern hands. There is, however, a large volume of better-class traffic on these routes, especially from Palace Gates, Noel Park, West Green, Seven Sisters, Stoke Newington, Stamford Hill, Wood Street, Highams Park, and Clapton stations, and for this reason the return halves of the cheap workmen's tickets are not available by many of the faster trains. There are, in fact, many trains on these routes which carry a large number of first-class season-ticket holders, besides a very considerable second-class traffic. On these routes, however, third-class accommodation is usually provided on a larger scale than on other services, and the problem of loading up of trains, even with a standard of 17 four-wheeled coaches at busy periods, is still acute, notwithstanding the enormous number of trains provided. Between Liverpool Street and Wood Street the all-night service of half-hourly trains is still a characteristic feature of the traffic.

The Loughton and Ongar line carries the *élite* of Great Eastern season-ticket traffic. This was one of the earliest sections to cater for residential traffic, and from the first has developed with a view to a good class of *clientéle*. It is only about three years ago that workmen's tickets were issued at all, and even now that applies only to Leyton and Leytonstone. The trains specially adapted to this route have a larger proportion of first and second-class accommodation. The system of packet tickets has, however, developed a considerable volume of third-class traffic on all suburban routes, including this section to some extent. The later bogie trains for local service were introduced first for this route, although a bogie train was put into service for Enfield and Walthamstow traffic as long ago as 1900.

The glories of Leyton, once a great feature of suburban traffic, have dwindled much in late years, but from Leytonstone onwards the districts served are of a superior character, and Snaresbrook, George Lane, Woodford, and other stations beyond, are adjacent to districts characterised by many large houses, the country around being, indeed, exceptionally picturesque. Gradients are severe in many places, but a very large traffic is conveyed. Beyond Loughton or Epping, according to needs, only portions of the trains are usually taken over the very hard section to Ongar, the concluding six miles being more or less agricultural. This line conveys a great deal of milk traffic, and several trains, especially those to and from Fenchurch Street, still maintain characteristics due to their early development for milk conveyance as well as for high-class residential traffic, though now most of the milk is worked on weekdays by special trains—these figure in the public time tables—to relieve the passenger trains of this element of possible delay at stations.



TEMPLE MILLS GOODS AND SORTING SIDINGS.

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Photo] [*W. A. Burns.*

GOODS TRAIN PASSING BRENTWOOD.
Belpaire goods locomotive No. 1223.

The Woolwich branch is obtrusively industrial, and business travel is the main feature, including a large transport of workmen. There are numerous trains between Stratford Market and Custom House, with fast trains between Fenchurch Street and the Royal Albert Docks running *viâ* Bromley direct to Canning Town, during business hours—10.23 a.m. and half-hourly to 4.23 p.m. down—but at other periods trains are considerably fewer, and the Gallions section is only served by through trains between

BISHOPSGATE GOODS STATION.

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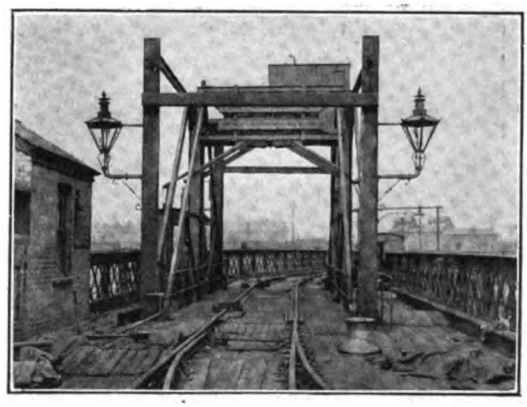
about 9 a.m. and 5 p.m., the remaining facilities being given by locals from Custom House. Otherwise the traffic on this branch is provided by half-hourly trains from Fenchurch Street and hourly trains from Liverpool Street to Woolwich *viâ* Stratford Market, half-hourly trains from Fenchurch Street to Gallions during the hours indicated only, approximately hourly trains between Palace Gates and Woolwich, half-hourly Victoria Park-Canning Town locals, additional trains between Stratford or Stratford Market and Woolwich as required, and the special service of Stratford-Beckton trains already referred to. There is actually a very full service, but the trains are light and much of their traffic is intermediate and of a workmen's character, hence the somewhat second-rate vehicles generally employed.



WHITECHAPEL COAL HOIST, GENERAL VIEW.

Along the Ilford route there is now a very plentiful service of suburban trains, and when residential traffic is heavy a large proportion are fast between Liverpool Street and Maryland Point or Forest Gate, and others fast between Liverpool Street and Ilford, giving splendid facilities for the rapidly developing districts served by Ilford, Seven Kings, Goodmayes, and Chadwell Heath stations. These trains load up very heavily, and a few 20-coach four-wheeled sets are in use therefor. During the slack hours a feature is that there are regular trains fast between Stratford and Bishopsgate or Liverpool Street. During the working rush there are several up trains which serve only one or two stations. Most of the Fenchurch Street-Ilford trains are slow, as also the Liverpool Street-Barking trains. There are also very good trains from Romford and stations thence to Chelmsford, and of late years the outer suburban traffic in this connection has received special attention.

As regards other London lines, it only remains to mention the Cambridge line "locals"—a very good service is provided, but the traffic is not so heavy as on other sections, though the new time tables should attract a great deal more in view of the good trains now provided—together with the special Hertford services and the short trains from Stratford to Lower Edmonton and Waltham Cross; the Fairlop trains from Liverpool Street *viâ* Woodford, or from Woodford to Ilford and back to one of the London termini or *vice-versa*; and the Fenchurch Street-Blackwall trains, over the original route of the Blackwall Railway, with the connecting trains on the Millwall Extension Railway from Millwall Junction to North Greenwich.

WHITECHAPEL COAL HOIST, INTERIOR.

Cambridge Main Line and Branches.

Proceeding down the Cambridge line, beyond Tottenham the first branch is that to Lower Edmonton, now used by very few trains, mainly short ones to and from Stratford, though some of the special early morning "workmen's" trains travel this way.

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REFRESHMENT ROOM, PARKESTON QUAY.

This route was in early days the Enfield branch, but has long since lost that character, and it is now quite a secondary section. From Broxbourne the Hertford branch is put off, dividing again at St. Margarets for Buntingford. Hertford has a good service, including many through trains to and from Liverpool Street, but some of the best services are given by main line trains stopping or "slipping" at Broxbourne. The Buntingford branch has through carriages in some cases. This district is rapidly developing for residential traffic, including Hoddesden, virtually an annexe of Broxbourne, and other intermediate stations, as well as Broxbourne, St. Margarets, and Hertford itself. The train facilities are, indeed, particularly good for these stations, with a somewhat notable series of Hertford fasts in addition to the ordinary trains and connections.

From Bishops Stortford the Dunmow and Braintree line provides a cross-connection with the Colchester route at Witham, but in addition to through trains there are also locals at each end. From Elsenham the Elsenham and Thaxted Light Railway is put off, this being owned and worked by the Great Eastern Company. From Audley End there is the Saffron Walden branch, connecting at Bartlow with the cross-country route from Shelford *viâ* Haverhill (serving one end of the Colne Valley line), Long Melford (joining the Bury St. Edmunds line) and Chappel (serving the other end of the Colne Valley line) to the Colchester route at Mark's Tey.

Beyond Shelford the line from Foxton comes in, this being a Great Eastern section continued by the Great Northern branch to Hitchin, and although Great Eastern property from Foxton station to the Cambridge main line, is used only by Great Northern trains.

Cambridge is, of course, the traffic centre of the whole of this area. London and North Western trains come in by their own route to the south of the famous station, and to the north diverge, (1) the Newmarket branch, continued as what is almost a cross-country main line through Bury St. Edmunds to the Ipswich-Norwich main line at Haughley, (2) the Barnwell route to Fordham and the Mildenhall branch, (3) the Ely main line, and (4) the St. Ives and Huntingdon line, also used by Midland trains from Bedford to Cambridge.

Ely, again, is an important centre, with three routes converging from the south—from Cambridge, St. Ives, and from Bury St. Edmunds or Newmarket—and three to

ARRIVAL OF CONTINENTAL TRAIN AT PARKESTON QUAY.

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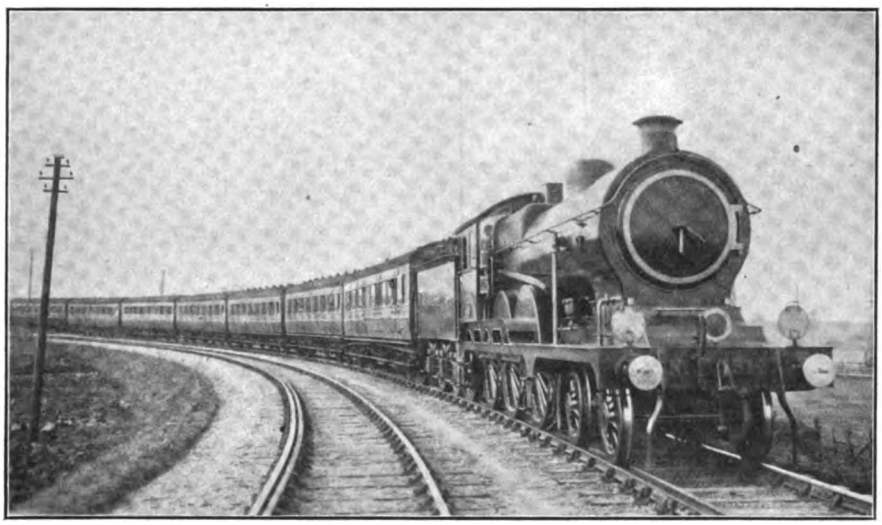
the north, the Thetford-Norwich main line, the King's Lynn and Hunstanton route, and the direct line to March. The last-mentioned station is, to all intents and purposes, the Great Eastern frontier towards York, and virtually constitutes the commencement of the Great Northern and Great Eastern Joint Line. Great Eastern trains do local work as far as Spalding, while beyond that point both the owning companies work trains, express, stopping and goods or mineral. The Peterborough branch counts for little as regards London passenger traffic, but it is exceedingly important locally, and is a very big factor in interchange goods and mineral traffic, connections being made with the Great Northern, Midland, and

trains at business hours, with various fasts at other periods, and is exceptionally well served since the Great Eastern seriously entered the field as a competitor for Southend traffic. Although a branch, most of the trains are run direct to and from London, the usual system being the combination of fast and slow branch portions, divided or joined at Shenfield, but a few connections are given off main line trains. From Wickford diverges the Burnham-on-Crouch and Southminster branch, with a few through carriages, and one through up train daily, in addition to good connections. From Woodham Ferrers branch trains run to Maldon as an alternative route to that *viâ* the main line at Witham.



Photo] [*W. H. Kelland.*

GREAT EASTERN RAILWAY.

Newmarket Luncheon Car Special, near Cambridge; 4–6–0 locomotive No. 1514.

London and North Western systems. At Whittlesea there are extensive sidings for the stowage and marshalling of goods and mineral trains. Through carriages are operated between Birmingham (London and North Western Railway) and Harwich by this route, in connection with the Harwich and York Continental expresses.

Colchester Main Line and Branches.

The first branch on the Colchester main line beyond the suburban area is that from Shenfield to Southend. This line has virtually a half-hourly express service of residential

Proceeding along the main line, Witham has the Braintree and Maldon branches, already mentioned; at Kelvedon the Kelvedon and Tollesbury Light Railway, owned and worked by the Great Eastern Company, together with the pier at Tollesbury, makes connection; and at Mark's Tey the Long Melford and other cross-country lines already referred to come in, this station also giving the best access from London to the Colne Valley Railway *viâ* the junction at Chappel.

Colchester, with a short local branch to St. Botolph's, is an important centre, and is the junction for the Clacton-on-Sea branch—

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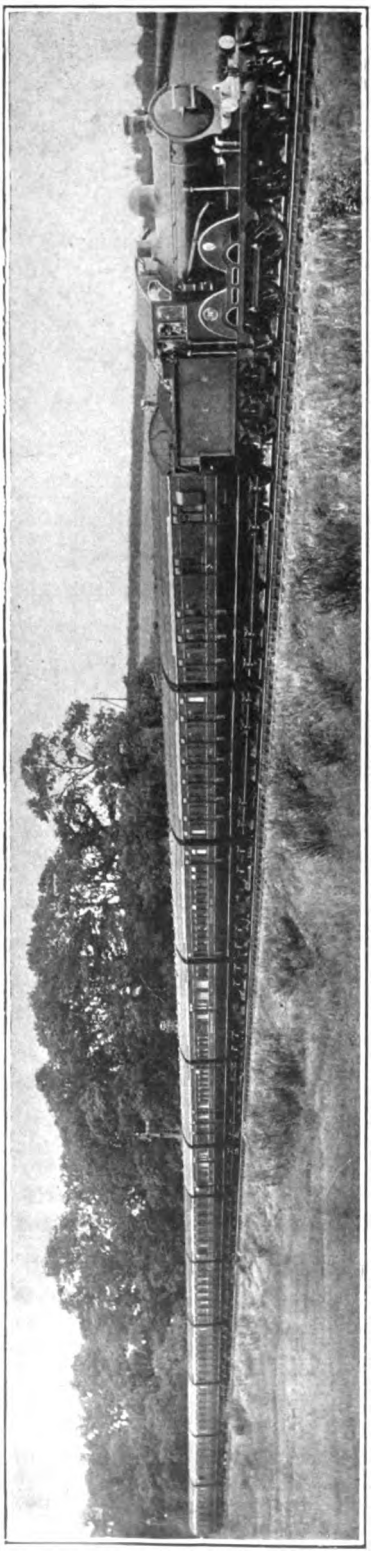
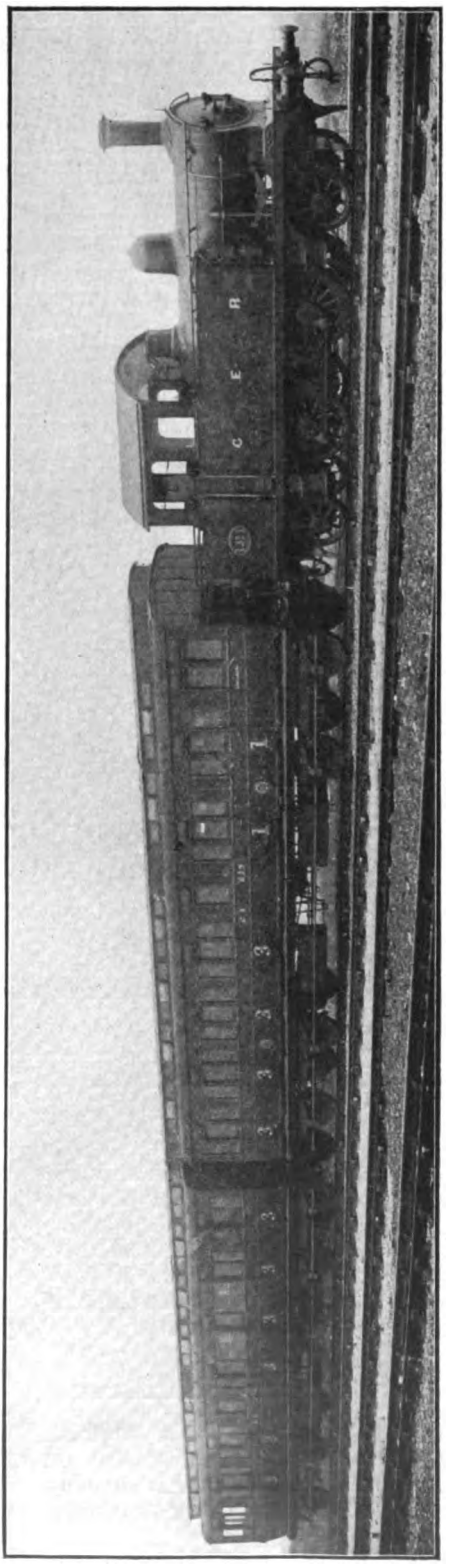


YORK, LIVERPOOL, MANCHESTER, LEEDS AND BIRMINGHAM-HARWICH CONTINENTAL RESTAURANT CAR TRAIN.



MOTOR-TRAIN RECENTLY INTRODUCED ON THE CAMBRIDGE-MILDENHALL SERVICE.
One of the small 2-4-2 tank engines, 1300 class, is utilised for this.

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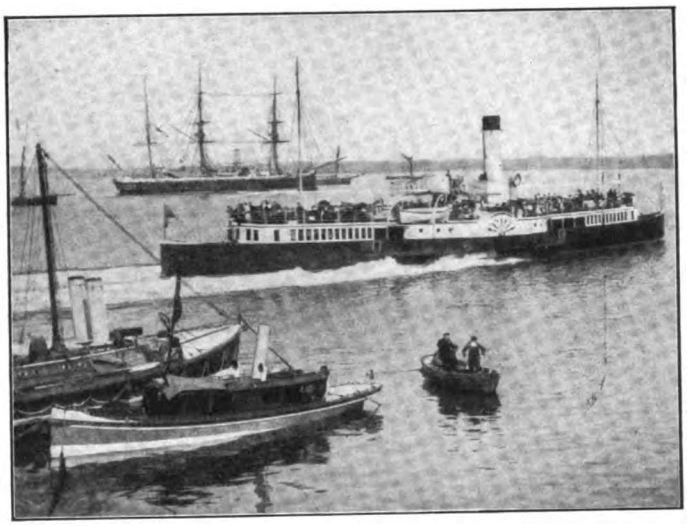
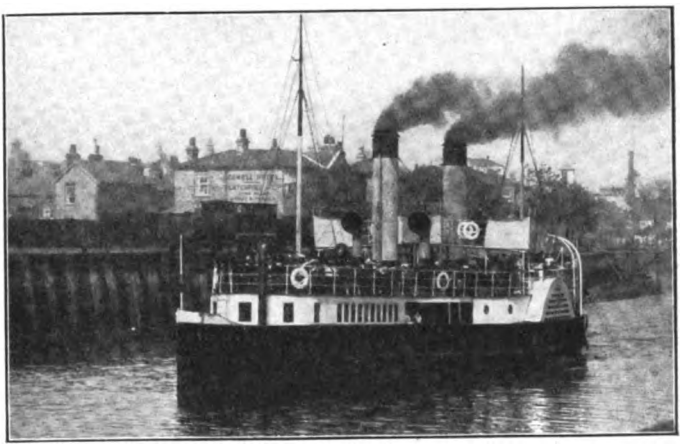
now almost a main route, with a number of good expresses from London as well as effective main line connections and through vehicles—from which is put off the Wivenhoe-Brightlingsea section, and at Thorpe-le-Soken the Frinton-on-Sea and Walton-on-the-Naze branch, which shares in most of the Clacton facilities.

From Manningtree diverges the Parkeston Quay and Harwich branch, best known because of the Continental traffic served thereby, but almost equally important on its own account because of the industrial and naval traffic of Harwich, and the favour in which Dovercourt Bay is held as a holiday resort, shared in a lesser degree by Harwich itself, assisted as it is by the presence of the Great Eastern Company's hotel facing the sea and adjacent to the station. At Parkeston there are long quays for the steamers, with well equipped premises suited to the traffic, and effective provision for cargo transfer. From here the Great Eastern turbine steamers leave, in normal times, for the Hook of Holland, and twin screw steamers for Antwerp, and for cargo only to Rotterdam, while other lines of steamers proceed to Hamburg, Esbjerg, and during the summer months to Gothenburg.

From Bentley diverges the short Hadleigh branch, while Ipswich is the great dividing centre for the coast traffic. To the north is the main line to Norwich and Cromer, while the East Suffolk line follows the coast, with branches from Westerfield to



RIVER STEAMER *Suffolk*, OFF HARWICH PIER.



RIVER STEAMER *Suffolk*, LEAVING IPSWICH.

MOTOR FERRY BOAT *Pin Mill*.

Equipment for River Steamer and Motor Boat Services.

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Photo] [*H. T. Worlock.*

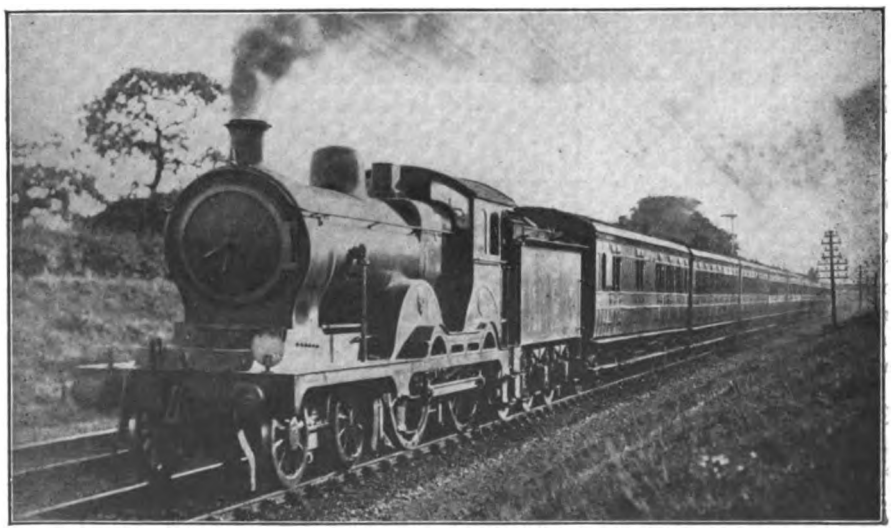
EAST ANGLIAN LUNCHEON CAR EXPRESS.

4–6–0 locomotive No. 1500 (the first of the class).

Felixstowe, from Wickham Market to Framlingham, from Saxmundham to Aldeburgh, from Halesworth to Southwold (by the Southwold narrow-gauge railway), and from Beccles to Lowestoft on the one side and across to Tivetshall by the Waveney Valley line on the other.

Between Norwich, Yarmouth and Lowestoft, and between Yarmouth and Lowestoft, there are quite complicated systems of lines, with good facilities, numerous trains (many of them fast or semi-fast) connecting these busy places. The latest addition is the Yarmouth-Lowestoft coast line through Gorleston-on-Sea, now a favourite resort at the north of the River Yare, this route being joint with the Midland and Great Northern Joint system.

At Yarmouth the two Great Eastern stations at South Town (in Suffolk) and at Vauxhall (in Norfolk) are not connected in any way, but between them they deal with an enormous traffic in the holiday season; one or the other being used according to the route taken and convenience for particular journeys. Norwich also has two stations, the old one at Victoria and the newer one, now the chief, at Thorpe. In the Cromer district the Great Eastern is again associated with the Midland and Great Northern Joint



Photo] [*F. E. Mackay.*

SOUTHEND TEA-CAR EXPRESS.

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system, at North Walsham for the Mundesley branch, and from the outskirts of Cromer to West Runton and Sheringham.

Main Traffic Routes.

In addition to the routes mentioned here, are cross and connecting lines in all directions. Examination of the map on page 174 will show most of these, but it is interesting to note that a large number of stations form connections with a multiplicity of branches.

In regard to traffic facilities, it will be sufficient to enumerate the principal factors of more than local importance :—

(1) London-York through expresses *viâ* Cambridge, Ely, March, Spalding, Sleaford, Lincoln, Gainsborough, Doncaster and Selby.

(2) London to Wisbech, King's Lynn, Hunstanton and Wells, *viâ* Cambridge and Ely.

(3) London to Norwich, Cromer, Yarmouth and Lowestoft, *viâ* Cambridge, Ely and Thetford. This is secondary as regards through London traffic, but counts for much on an intermediate basis, while a considerable volume of cross-country traffic, including the through carriages from the London and North Western system *viâ* Peterborough, and the through summer trains from the Great Central system and the north *viâ* Lincoln and March, comes on to it.

(4) London, Cambridge, Newmarket and Bury St. Edmunds, with that catered for by the new semi-fast trains on the cross-country route from Cambridge to Haughley and Ipswich.

(5) The same cross-country route in association with trains from the north, including the York, Liverpool, Manchester, Sheffield, Leeds and Harwich Continental restaurant car express.

(6) London-Cromer, Mundesley, Sheringham traffic, now catered for by good trains, *viâ* Ipswich, and particularly by the special Norfolk Coast expresses operated during the summer months.

(7) London-Norwich traffic *viâ* Ipswich. By this route the principal trains are now worked, and the facilities are particularly good.

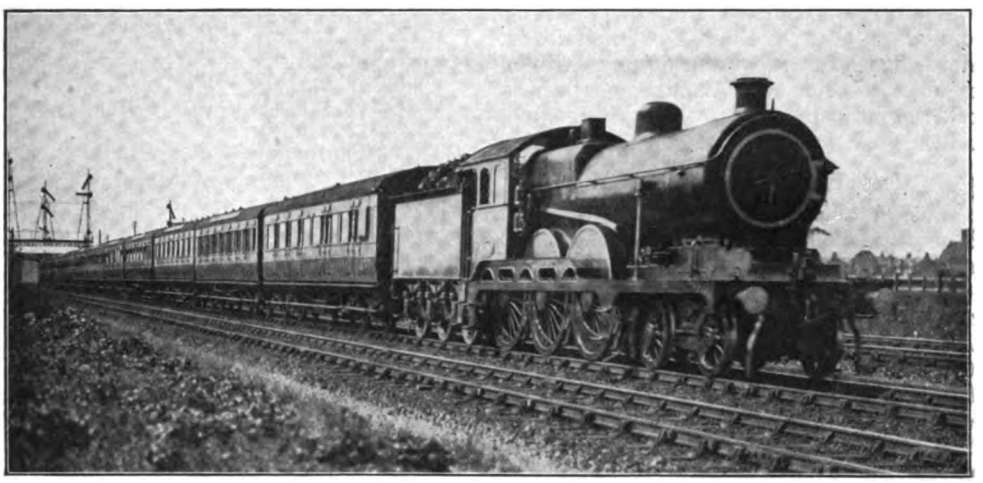
(8) London-Yarmouth and Lowestoft *viâ* Ipswich. This is the chief route for traffic between these places, and again has very good facilities, including non-stops and other special trains during the holiday periods.

(9) London-Felixstowe traffic, in some cases worked on its own account, in others in association with the main line services.

(10) London - Harwich, including the special Continental trains, in addition to good facilities otherwise.

(11) London-Clacton-on-Sea and Walton-on-the-Naze, largely catered for by special through trains adapted for residential and week-end traffic.

(12) London-Southend services. Also worked on the basis of fostering residential as well as holiday travel.



Photo] [*F. E. Mackay.*

NORFOLK COAST EXPRESS.

4-6-0 locomotive No. 1505 (the first of the second series of these engines).

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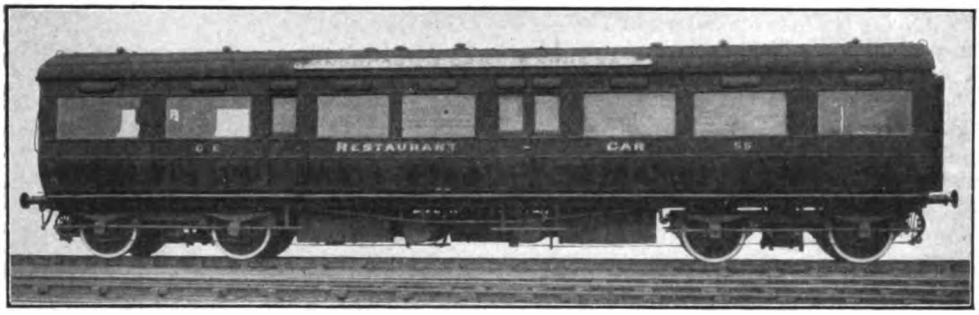


RESTAURANT CAR, AS USED FOR NORFOLK COAST EXPRESSES.

(13) Norwich-Yarmouth-Lowestoft local, stopping and express services.

In connection with many of these, and especially the Colchester routes, it may be pointed out that the Great Eastern Railway affords in most cases, and particularly in reference to Cromer, Yarmouth and Lowestoft, the most direct route between London and the great watering places of East Anglia.

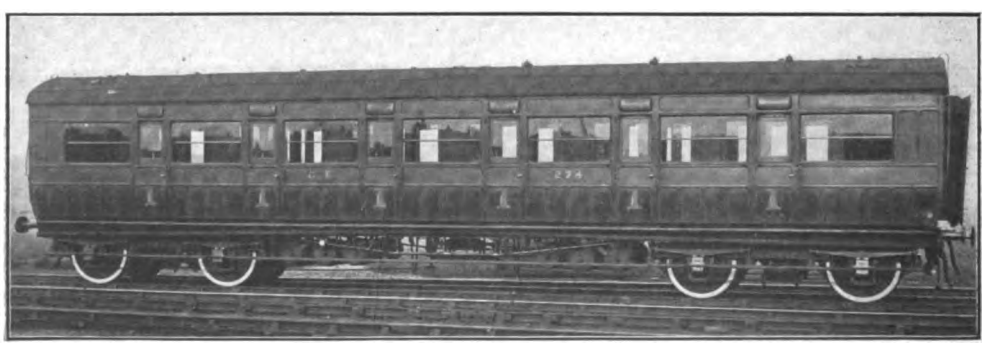
Express Train Facilities.

Table IV. sets forth the distances and best times realised on the chief routes, winter and summer.

The longest non-stop runs are given in the summer only, from Liverpool Street to North Walsham (131 miles in 158 min.), Liverpool Street to Trowse (114 miles in 137 min.), Liverpool Street to Yarmouth (121¾ miles in 150 min.), and Liverpool Street to Beccles (109¼ miles in 142 min.). All the year round, the best runs from or to Liverpool Street are now Ipswich (68¾ miles in 84 min.), Colchester (50½ miles in 62 min.), Parkeston Quay (68¾ miles in 82 min.), Thorpe-le-Soken (66¼ miles in 83 min.), Prittlewell (40¾ miles in 53 min.), Cambridge (55¾ miles in 70 min.), Ely (70½ miles in 87 min.).

Table IV.

		Distance.	Best Winter Times.	Best Summer Times.
			H. M.	H. M.
London	—Cromer ..		3 6	2 55
,,	—Sheringham ..		3 30	3 18
,,	—Yarmouth ..		2 51	2 30
,,	—Lowestoft ..		2 43	2 36
,,	—Southwold ..		3 22	3 23
,,	—Aldeburgh ..		2 33	2 31
,,	—Felixstowe ..		2 8	1 53
,,	—Parkeston Quay		1 22	1 22
,,	—Harwich ..		1 34	1 34
,,	—Clacton-on-Sea		1 35	1 35
,,	—Walton-on-the-Naze		1 39	1 39
,,	—Southend-on-Sea		55	55
,,	—Burnham-on-Crouch		1 12	1 12
,,	—Colchester ..		1 2	1 2
,,	—Ipswich ..		1 24	1 24
,,	—Norwich ..		2 22	2 22
,,	—Cambridge ..		1 10	1 10
,,	—Ely ..		1 27	1 27
,,	—King's Lynn		2 6	2 6
,,	—Hunstanton ..		2 45	2 45
,,	—Wells ..		3 25	3 25
,,	—Newmarket ..		1 40	1 40
,,	—Bury St. Edmunds		2 2	2 2
,,	—Spalding ..		2 14	2 14
,,	—Sleaford ..		2 40	2 40
,,	—Lincoln ..		3 12	3 12
,,	—Doncaster ..		4 6	4 6
,,	—York ..		5 5	5 5



STANDARD MAIN LINE CORRIDOR CARRIAGE.

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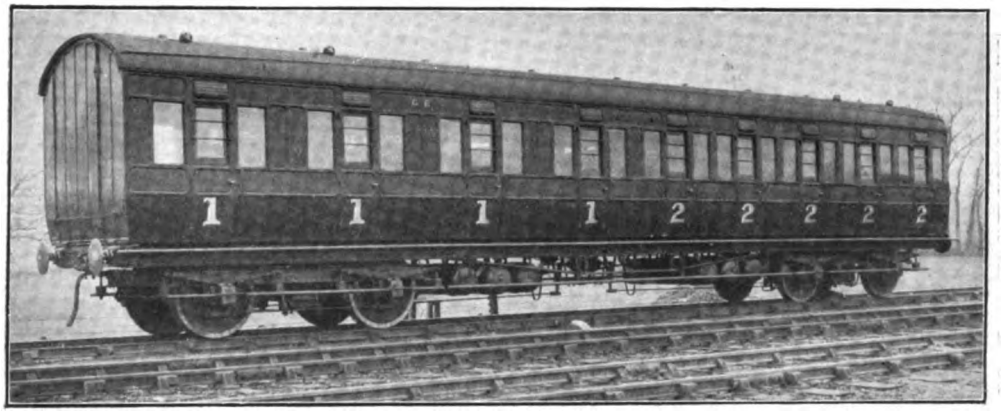

1ST AND 2ND COMPOSITE CARRIAGE AS USED FOR THE NEW STANDARD SUBURBAN BOGIE SETS.

In some respects the Great Eastern Railway now provides the most remarkable services of restaurant car facilities of any line. The list is illuminating, as follows :—

FROM LONDON (LIVERPOOL STREET).

(1)	8.30 a.m.	Cromer.
(2)	10.20 a.m.	Cromer.
(3)	11.50 a.m.	Ipswich.
(4)	12.25 p.m.	Hunstanton.
(5)	12.30 p.m.	Cromer (Saturdays only), on other days a car is run from Ipswich to Yarmouth.
(6)	1.0 p.m.	Yarmouth (Saturdays only); also car on slow portion Ipswich to Yarmouth.
(7)	1.20 p.m.	Southend (Saturdays only).
(8)	4.55 p.m.	Yarmouth.
(9)	5.0 p.m.	Clacton-on-Sea.
(10)	5.18 p.m.	Southend.
(11)	5.23 p.m.	Cromer.
(12)	5.52 p.m.	Hunstanton.
(13)	7.2 p.m.	Norwich.
(14)	7.45 p.m.	Lowestoft.
(15)	8.30 p.m.	Parkeston Quay.
(16)	8.40 p.m.	Parkeston Quay.
(17)	12.0 midn't.	Southend.
(18)	12.5 a.m.	Clacton-on-Sea (Saturday nights only).

TO LONDON (LIVERPOOL STREET).

(1)	6.0 a.m.	Parkeston Quay.
(2)	6.35 a.m.	Parkeston Quay.
(3)	7.6 a.m.	Clacton-on-Sea.
(4)	8.15 a.m.	Southend.
(5)	7.13 a.m.	Hunstanton.
(6)	8.10 a.m.	Cromer.
(7)	8.32 a.m.	Yarmouth.
(8)	10.3 a.m.	Lowestoft (*vid* Cambridge).
(9)	10.15 a.m.	Norwich.
(10)	12.37 p.m.	Ipswich.
(11)	1.28 p.m.	Cromer.
(12)	3.50 p.m.	Southend (Saturdays only).
(13)	5.5 p.m.	Hunstanton.
(14)	6.10 p.m.	Cromer.
(15)	5.40 p.m.	Yarmouth.
(16)	8.10 p.m.	Ipswich.
(17)	10.20 p.m.	Southend.

On Sundays, in addition to the Continental trains, restaurant car services are run from Cromer at 5.2 p.m. and from Yarmouth at 7 p.m. to Liverpool Street. Between York and Harwich restaurant cars are run on the Continental trains in each direction. A feature of some of these trains is that certain of them are semi-fast, so that they are available for intermediate journeys as well as for long-distance passengers, and a few of them follow unusual routes. On the

THE ORIGINAL GREAT EASTERN HOSPITAL TRAIN EQUIPPED AFTER THE OUTBREAK OF WAR.
Some of the vehicles of this train have since been sent for service in France, and replaced by others.

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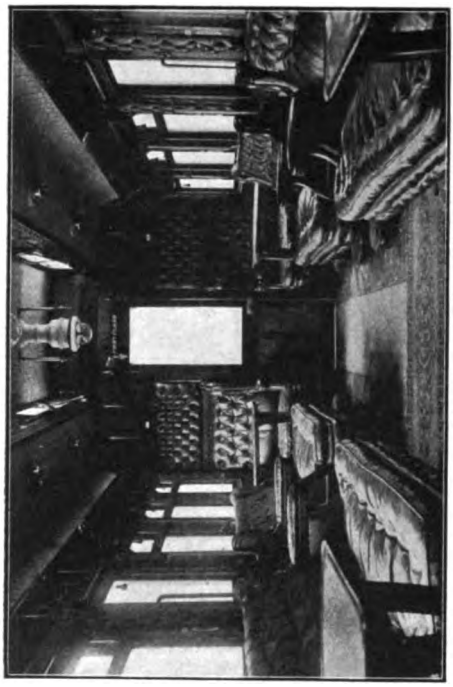
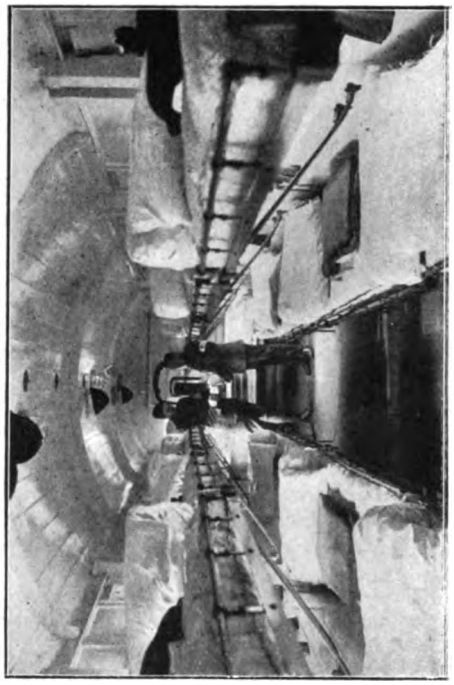
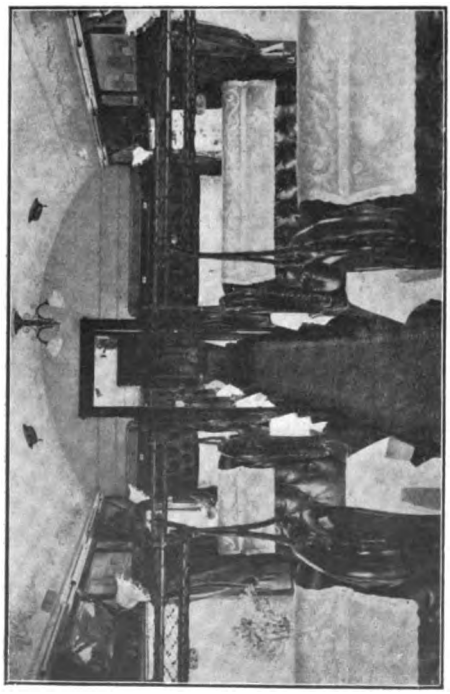


SMOKING LOUNGE OF FIRST CLASS RESTAURANT CAR.



INTERIOR OF WARD CAR; AMBULANCE TRAIN.



DINING SALOON, FIRST CLASS RESTAURANT CAR.

KITCHEN COMPARTMENT: NORFOLK COAST EXPRESS.

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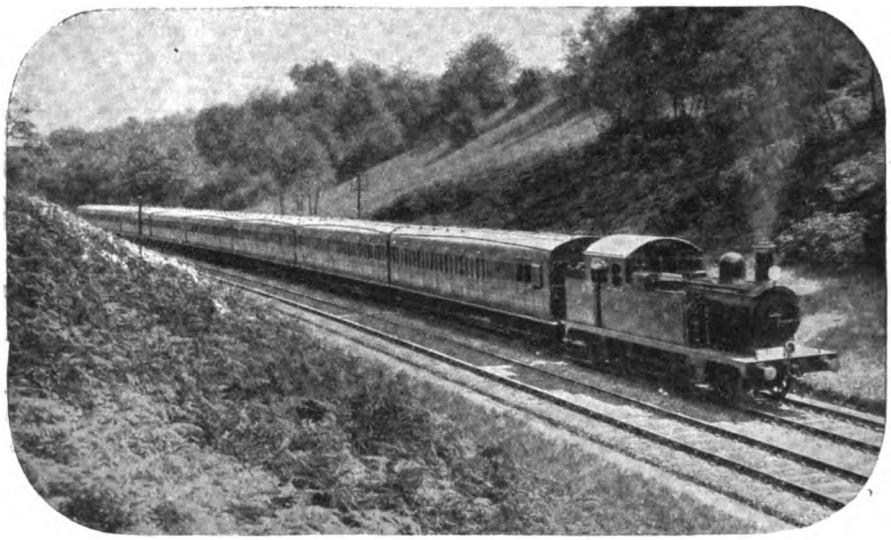
Southend services a special low tariff is in force. The special summer Norfolk Coast expresses also have restaurant cars.

The Great Eastern is the only line making special provision for meals for children, served according to the menu in smaller portions at half-price, and this facility is much appreciated when holiday traffic is heavy. It has been left to the Great Eastern Railway to introduce another feature in catering, this time for the despotic juvenile. "Baby's Comfort" is now a standing article on the menu card in the shape of a special food. On long-distance trains, nurse or mother can obtain hot water from the kitchen, and from the restaurant a supply of a suitable patent food.

(available by any train out and for return within 15 days); extra-journey tickets (to enable a member of a family holding tourist or fortnightly tickets to make one or more journeys to the home station during the vacation period or for business purposes); and weekly, fortnightly or monthly season tickets between seaside resorts and town. In addition, local season tickets are issued in suitable districts, while for places such as Felixstowe and Clacton-on-Sea there are ordinary season tickets, not available at intermediate stations, for people in business in London, at cheaper rates than those which can be used at other than terminal and certain specified stations. For longer journeys season tickets are first and third



BOGIE SUBURBAN TRAIN AS INTRODUCED FIRST FOR THE LOUGHTON AND EPPING SERVICES.
Photographed specially at a picturesque spot on Brentwood bank.

Another special facility associated with these services is that, in addition to supplying light refreshments in or from the cars, attendants traverse the trains with confectionery and fruit, this policy being particularly valuable when families are travelling to and from the various seaside resorts.

General Facilities.

As regards general facilities, the Great Eastern Railway has a number of special arrangements adapted to meet the requirements of its traffic. Of these may be mentioned, besides tourist, week-end and half-day, day, and period excursions on a generous basis, the well-known fortnightly tickets

class, but in the London area they are all first and second class. The only stations at which first, second and third class seasons are issued to and from the City termini are Harold Wood, Hertford (tickets here are also available at King's Cross, Great Northern Railway, but not intermediately on that route), and Romford. Seasons to or from Liverpool Street are now available also at Fenchurch Street, the slight addition hitherto charged being now discontinued. Arrangements for St. Pancras availability are also made when required. Associated with the ordinary arrangements are "Wives' Season Tickets" at half the usual rates, "Scholars'" and "Teachers'" tickets adapted to school

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term periods, and "half-price" arrangements for young people under 18 years of age, with discount allowances when two or more tickets are held by members of one family residing together. Through seasons are also issued between the Great Eastern and other railways, including the London underground lines.

Packet tickets, previously referred to, are purchasable in weekly sets at a reduction on the full ordinary prices. These are adapted for five-day use during holiday weeks. The workmen's traffic is partly operated as a graduated basis, there being "Twopenny" and "Threepenny" tickets between stations on the Enfield and Walthamstow routes, according to trains, while in several instances special tickets are issued limited to specific workmen's trains, whose loading is thus kept within bounds. There are also from most of the suburban stations cheap return tickets and express goods trains and sometimes take a share in excursion and special passenger working.

The tank engine stock comprises 256 engines of the 0–6–0 type, these including the condensing locomotives characteristic of the Enfield and Walthamstow services, though also used elsewhere, as well as the true goods classes, with the small 0–6–0 tanks used on the Fenchurch Street-Blackwall and a few other services; the 1100 class of 0–4–4 tank engines, numbering 40; the 2–4–2 classes, the usual standards, including the new and rebuilt locomotives with higher pressure boilers, and the smaller branch line engines of the 1300 class, the total of the 2–4–2 type being 239 engines; and the 0–4–0 yard shunting and train 0–4–0 and 0–6–0 engines in use in certain districts. A somewhat notable development of the tank engine designs is the building of two having

CONVERTED BOGIE SUBURBAN TRAIN.

Consisting of eight 27 ft. bodies mounted in pairs on 54 ft. underframes, and carried by four-wheeled bogies.

to London by trains arriving at the termini before 8 a.m.

Locomotives and Rolling Stock.

Great Eastern locomotive practice is now essentially up-to-date, there being 34 large 4–6–0 superheater engines for the heavier express duties and 171 locomotives of the 4–4–0 class, largely of modern design; with 110 of the 2–4–0 type, these being mostly of the 420 class adapted for mixed-traffic use. The Great Eastern is, on the whole, a distinctly hard road, and its difficulties are by no means few; but the engines built by Messrs. J. & S. D. Holden and more recently by Mr. A. J. Hill, perform very meritorious work in an unobtrusive but none the less praiseworthy manner. For goods traffic there are 417 six-coupled engines, many designed particularly for heavy mineral traffic, while the others handle the ordinary six-coupled wheels and a trailing bogie (0–6–2). These are primarily for use in connection with the heavy bogie suburban trains.

Modern passenger rolling stock is distinctly good, and has a reputation, largely shared by the older vehicles, though outward appearances may not always do them justice, for internal comfort, without any special external elaboration. All suburban stock seats 6 passengers a side in second and third class compartments, whether four-wheeled or of the new bogie classes. Main line stock includes bogie corridor (vestibuled or independent) carriages, a large proportion other than those forming specified trains being composite with luggage accommodation. There are as many as 52 restaurant cars. As one of the "Royal" lines the Great Eastern has provided special saloons for the journeys of their Majesties the King

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and Queen and Queen Alexandra to and from Wolferton, the station for Sandringham. Goods rolling stock is mainly of ordinary designs, there being little occasion for special classes.

A few years ago the Great Eastern Railway operated a number of routes with motor road vehicles, but some of these have since been transferred to other ownership, so that 5 only appear in the Company's record. These run between Ipswich and Shotley and between Norwich and Loddon, but private agencies, some of them based upon provision previously made by the Great Eastern Railway, supply services between Chelmsford and Writtle, Great Baddow, Danbury, Great Waltham, Boreham, Galleywood and Leaden Roding; Lowestoft, Kessingland and Southwold; Harwich and Upper Dovercourt; and Emerson Park and Squirrels Heath.

Steamer Services.

For the Continental traffic the Great Eastern Railway employs the following steamers:—

		Length.	Breadth Beam.	Tonnage.	Indicated H.P.
		feet.	feet.		
S.S. *St. Petersburg* (Turbine)	Fitted with Wireless Telegraphy and Submarine Signalling.	343	45	2,500	10,197
S.S. *Munich* ,,		343	45	2,500	8,961
S.S. *Copenhagen* ,,		343	45	2,600	9,208
S.S. *Amsterdam* (Twin Screw)		314	37	1,800	5,800
S.S. *Louvain* ,, ,,		314	39	1,900	6,000
S.S. *Vienna* ,, ,,		314	37	1,800	5,800
S.S. *Brussels* ,, ,,		294	35	1,400	3,900
S.S. *Colchester* ,, ,,		291	32	1,300	2,440
S.S. *Clacton* ,, ,,	Cargo only.	253	32	900	1,970
S.S. *Cromer* ,, ,,		253	32	900	1,952
S.S. *Newmarket* ,, ,,		253	32	900	2,000

All the passenger steamers are lighted by electricity and carry life-saving appliances in accordance with the Board of Trade Regulations. The Turbine Steamers *St. Petersburg*, *Munich* and *Copenhagen* have a large number of cabins on the awning deck, and special state rooms on the main deck. In addition, there are a large number of two-berthed cabins. The *St. Petersburg* has a "cabin de luxe." The steamer *Louvain* has six deck cabins, the steamers *Amsterdam*, *Vienna* and *Brussels* four deck cabins, and the steamer *Colchester* two deck cabins each containing four berths. The steamers *Louvain*, *Amsterdam* and *Vienna* (in addition to those given above) have two deck cabins, each cabin containing two berths. The *Vienna* has one single berth deck cabin. The *Amsterdam*, *Louvain* and *Vienna* have on the main deck two large special state rooms containing two berths each, and the *Brussels* one large special state room containing two berths.

These boats rank highly among steamers of their class, being well equipped with first-class passenger arrangements, in addition to being thorough seaworthy and speedy vessels. The Great Eastern Railway also operates the steamers *Norfolk* and *Suffolk* in regular services along the River Orwell below Ipswich, Felixstowe and Harwich, while the motor boats *Epping*, *Hainault* and *Pin Mill* run on ferry service.

As regards other aspects of Great Eastern activity may be mentioned the joint lease with the Great Northern Railway of the Fossdyke Navigation Canal; the ownership of Lowestoft Harbour (1,099 ft. of quayage), Parkeston Quay (2,809 ft. of quayage), and Harwich Harbour (3,021 ft. of quayage), previously referred to incidently; the splendid hotels at Liverpool Street, Parkeston Quay, Harwich and Hunstanton; the special traffic in garden and dairy produce and in fish, direct from farms and merchants to private producers; and arrangements for seawater conveyance from the coast to private residences as already mentioned. Reference may also be made to the fact that no fewer than 71 stations are recognised as centres for golfing traffic to and from links in the neighbourhood. Great Eastern arrangements for representation in the United States and in Europe, as well as in British towns away from their own system; the "luggage in advance" and special "parcels" traffic arrangements; and the inclusive terms covering week-end or period residence at the Liverpool Street, Hunstanton (Sandringham Hotel) and Harwich Hotels in addition to railway fare, need only be mentioned.

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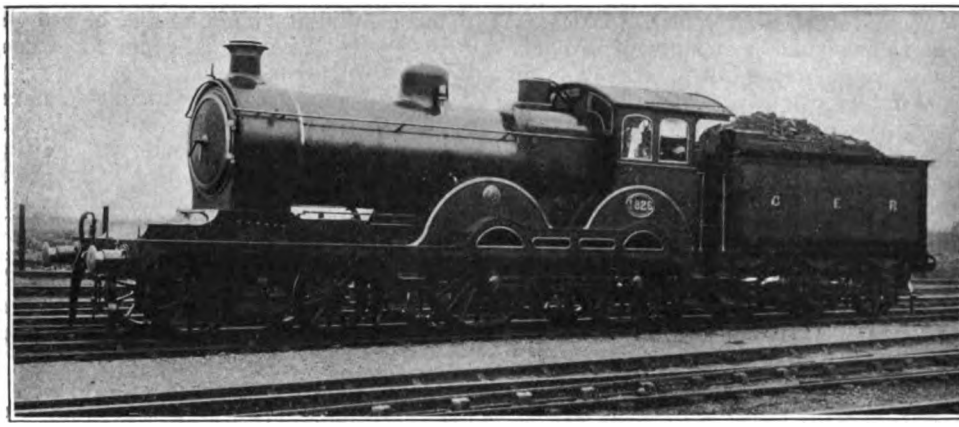


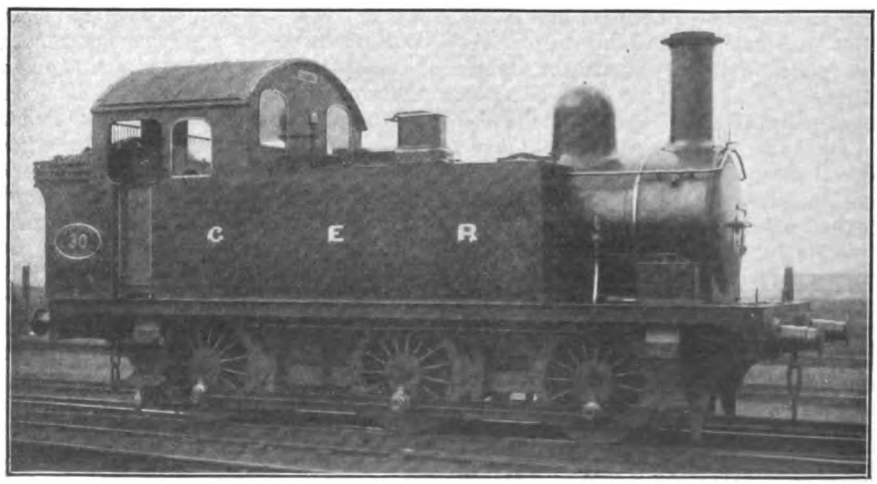
4–4–0 LOCOMOTIVE NO. 1826, FITTED WITH "TOP-FEED" ARRANGEMENT.

In many places facilities specially favour the erection of factories and of warehouses on sites adjacent to the Great Eastern lines, and private sidings are laid in where justified. In numerous districts conditions are particularly favourable to the development of new industries in this way.

One could deal at great length with many other features of Great Eastern traffic, besides developing phases already mentioned; but enough has been said to show the importance and scope of operations of this leading line, and a few remarks concerning the *personnel* of the directorate and management will be sufficient for present purposes.

As Chairman of the Board, Lord Claud Hamilton, M.P., has become a power in the railway world. The Deputy Chairman, The Right Hon. Sir Ailwyn Fellowes, K.C.V.O., is also now recognised as one of the ablest of railway administrators. The other directors are Lord Eustace Cecil, J. K. Foster, Esq., W. J. Galloway, Esq. (well-known because of his active interest in the musical and social side of railway staff affairs), Sir Frederick Green, C. E. Hambro, Esq. (associated with Mr. Galloway in social and musical matters), The Right Hon. Viscount Knollys, G.C.V.O., G.C.B., K.C.M.G. (for a long period private secretary to the late King Edward), Sir A. T. Lawson, and J. T. Mills, Esq.

Mr. H. W. Thornton, General Manager, came in 1914 as an importation from the United States, but has already made his mark and taken his place among Great Eastern staff as one of themselves, respected



0–6–0 TANK ENGINE FOR LOCAL GOODS AND SHUNTING WORK.

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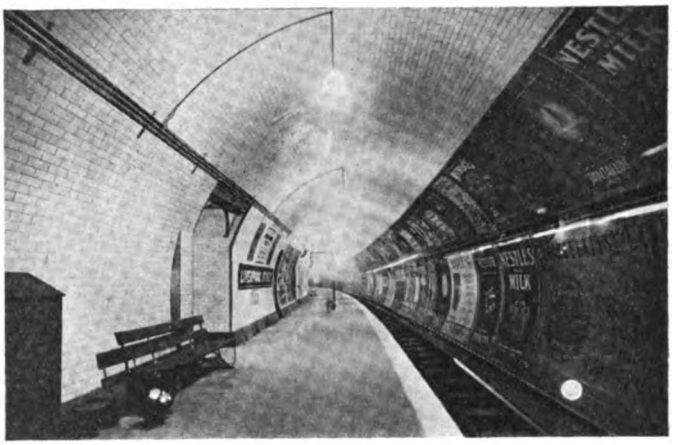
by his departmental colleagues and by the board, as well as by the ordinary members of the staff. He entered the service of the Pennsylvania lines west of Pittsburgh in December, 1894, and in 1895 was appointed assistant engineer on the construction of the Cleveland and Marrietta Railroad, one of the subsidiary lines of the Pennsylvania Company. In 1899, Mr. Thornton became Engineer for Maintenance of Way on the Erie and Ashtabula division, and on March 1st, 1901, he was made Superintendent of the Marrietta division of the Cleveland and Marrietta Railroad. In May, 1902, he was appointed Superintendent of the Cleveland, Akron and Columbus Railroad, and on December 23rd, 1902, was transferred to the Erie and Ashtabula division. On February 1st, 1911, he was appointed Assistant General Superintendent of the Long Island Railroad, and on November 14th, 1911, he was advanced to the post of General Superintendent. In February, 1914, he was selected by the directors of the Great Eastern Railway to follow Mr. W. H. Hyde as General Manager.

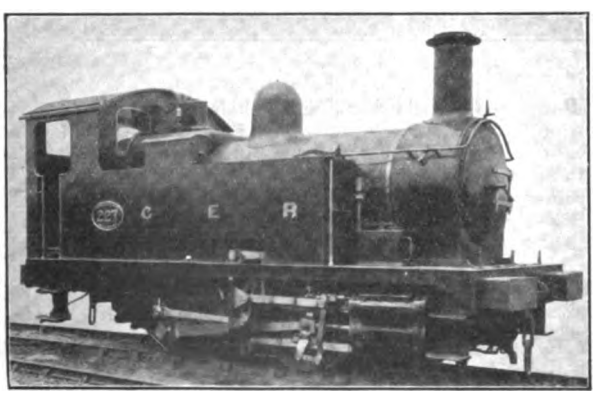


LIVERPOOL STREET ("TUBE" STATION): CENTRAL LONDON RAILWAY.

Mr. Lomas's appointment as Secretary dates from January 1st, 1910, but he had been Assistant Secretary since 1907. He joined the Great Eastern Railway in 1879.

Mr. Wm. C. May, Chief Traffic Manager, entered the service of the Great Eastern Railway in the Rates office of the Goods Department in January, 1886. In March, 1903, Mr. May was appointed Mineral Manager, afterwards being promoted to the position of Goods Manager in 1910. He now holds the post of Chief Traffic Manager, having under his control all the Traffic Departments — Passenger, Goods and Mineral.

Mr. Horace Wilmer, M.Inst.C.E., who recently succeeded Mr. Harry Jones as Chief Engineer, was educated at Rugby School. In 1871 he passed into the Indian Civil Engineering College, Coopers Hill, and was appointed in 1874 Assistant Engineer 2nd grade in the Indian Public Works Department. He was employed for two years under Col. Sankey, R.E., in works of irrigation in the province of Mysore, but for domestic reasons resigned his appointment in 1876 and returned to England. He entered the service of the Great Eastern Railway Company in May, 1877, and was employed as Resident Engineer on the construction of the Bishopsgate Goods depot. In 1882 he was appointed Engineer of the Southern Division and has remained in charge of this division up to the present time. During that time he has carried out extensive works of construction and has had considerable experience of the maintenance of permanent way.



0-4-0 SPECIAL TANK ENGINE FOR HEAVY YARD SHUNTING.

Mr. A. J. Hill, the present Locomotive Superintendent, entered the service at Stratford in 1877, passed through a course of training in the workshops and drawing office of the Locomotive, Carriage and Wagon Department, and in 1882 obtained a Whitworth Scholarship.

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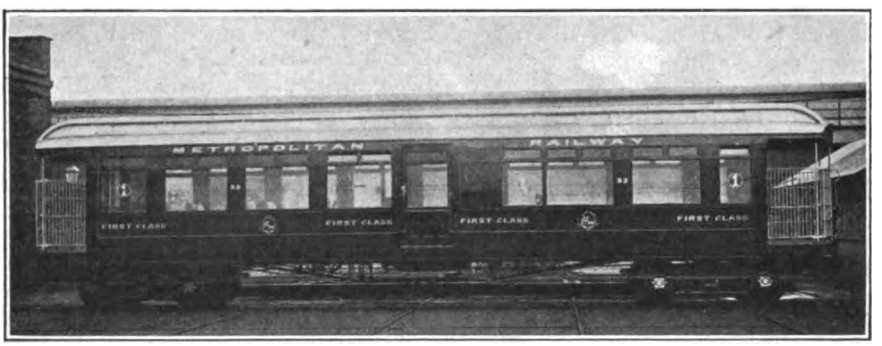
After acting for some years as Assistant Works Manager, he was in January, 1899, promoted to be Manager of the Locomotive Carriage and Wagon Works, and received his present appointment in November, 1912. Mr. Hill is a member of the Institutions of Civil and Mechanical Engineers and President of the Institution of Locomotive Engineers. For many years he held the position of Chairman of the Committee of the Company's Technical Institution at Stratford.

Mr. A. E. Dolden, the Chief Accountant, may easily claim, in point of service, to be the oldest officer of the Company. Entering the Accountant's Office, then at Bishopsgate, in May, 1870, his whole career has been spent in that Department, and in October, 1903, he was promoted to his present position.

Mr. C. Busk, Continental Traffic Manager, entered the service in June, 1879, and was appointed Continental Traffic Manager in January, 1898. During the last ten years many important alterations and improvements in the steamship service to and from the Continent *via* Harwich and through connections on the Continent have taken place.

In conclusion acknowledgment must be made of the courteous co-operation of various officers of the Great Eastern Railway in supplying information incorporated above and in reference to illustrations utilised for this article.

FIRST CLASS ON THE GREAT NORTHERN AND CITY "TUBE" RAILWAY.



On and from February 15th, the Metropolitan Railway provided first-class accommodation on the Great Northern and City section between Moorgate and Finsbury Park. The provision of the first-class cars will not decrease the accommodation for third-class passengers, as a first-class car is added to the present trains. This is the first "Tube" line furnished with first-class carriages, and the innovation will undoubtedly arouse some interest in the travelling public using this means of transit. Hitherto first-class season and day ticket holders, to and from the suburban stations on the Great Northern Railway using the City line, have been obliged to travel during a part of their journey in third-class carriages. The disadvantage will now be removed, with the anticipated result that the growing popularity of this portion of the Metropolitan Railway system will receive considerable impetus. Commencing February 15th, fast trains between Finsbury Park and Moorgate were scheduled in nine minutes.

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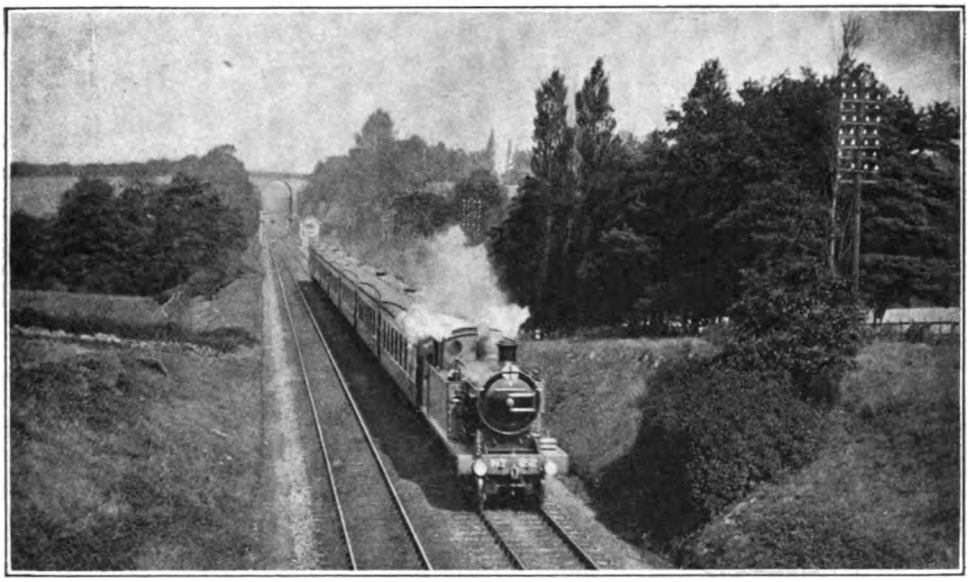

Photo] [*E. S. Hallett.*

LONDON BRIGHTON AND SOUTH COAST RAILWAY.

The Southern Belle, near Hayward's Heath. 4-4-2 superheater tank engine, No. 22.

British Locomotive Practice and Performance.

By CECIL J. ALLEN.

THE concluding paragraph of last month's article has suggested to me a topic for discussion in the present issue. A casual observer of locomotive working is often puzzled by the variation in character of the performance that he records. Engines of the same class, hauling the same loads, over the same stretch of line, under identical running conditions, will sometimes show a disparity in running times that is almost inexplicable. Again, a certain engine may make a frankly bad run on one occasion, and yet do brilliantly on another, without any apparent reason for the difference. A certain driver also, with a heavily laden express, to which his engine has been attached at an intermediate station, will make every effort to regain time for the loss of which he is in no way responsible, whereas another driver, with the same type of engine and a lighter train, under similarly late conditions of running, will be content to adhere strictly to his schedule throughout. Further, on some lines this regaining of time seems almost a tradition, whereas on other lines the tradition seems rather of the opposite order! The same tradition extends to hill-climbing, the engines of one line performing faster uphill work and travelling at more moderate downhill speeds than those of a neighbouring line, even though the grades be similar, and the locomotives nominally of the same tractive power. A consideration of some of these points may prove of interest.

First, then, we must examine the variation in locomotive working from the locomotive standpoint. Different engines of the same type, though identical in design, rarely show identical running characteristics. Of every express locomotive class drivers have their "favourite" engines, while others of the same type will be equally anathematized. I had an example of this recently on the London and North Western Railway, which shall be mentioned in order to show that accidents will happen, even "in the best-regulated families." On this particular occasion

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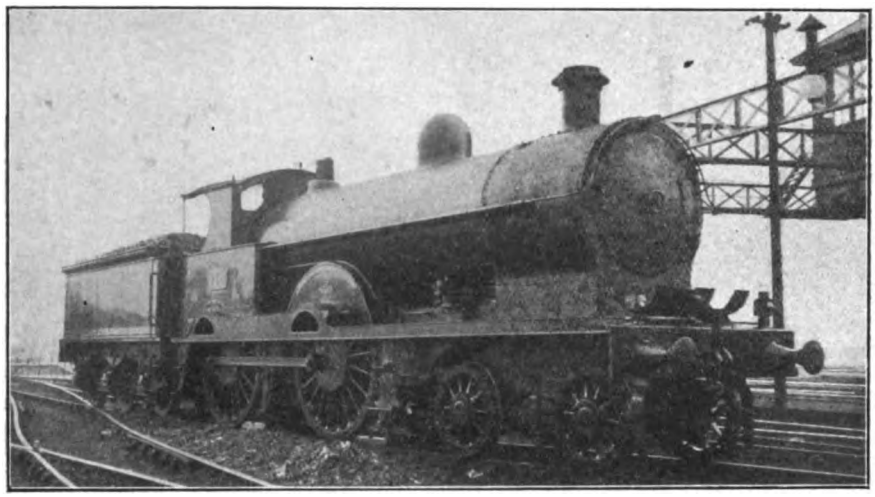

Photo] [*P. F. Cooke.*

LONDON AND NORTH WESTERN RAILWAY.

No. 2166, *Shooting Star*, fitted with Schmidt superheater and extended smokebox.

I was travelling from Carlisle to London by the 12.10 noon express, and as we were leaving 12 min. late with a not excessive load of 42 axles, or 310 tons, the presence of one of the latest batch of "Claughtons" at the head of the train seemed to presage a good run, more especially as this is an easy schedule. But, as a matter of fact, we took 28½ min. to Penrith, 17¾ miles, and no less than 51 min. to Shap Summit, 31¼ miles; from there we covered the 31½ miles down to Carnforth in 29 min. 50 sec. and the 27¼ miles on to Lancaster in 28 min. 50 sec. Thus we had lost 40 sec. on the booking of 109 min. for the 90 miles from Carlisle to Preston, despite the lateness of the train. From Preston to Crewe, with a reduced load of only 30 axles, or 225 tons, we took 63½ min. for the 51 miles, thus losing ½ min. on schedule, although it must be mentioned that we encountered a long and severe slack at Warrington and a signal check outside Crewe, costing together some 4 or 5 min.

In any case, though schedule time was kept, and the intermediate times could not be described as altogether unsatisfactory, the locomotive work, and especially the hill-climbing, was far below the usual "Claughton" standard. I gathered that this particular "Claughton" has the reputation of being an unsuccessful engine. While stationed at Crewe it did poorly, and since it has been transferred to Carlisle shed, with a different driver, its work has not improved. Such variations in locomotive running as this are the hardest of all to explain, as it is difficult to believe that there can be any difference in the quality of the constructional work put into the engine sufficiently great to account for the indifferent character of its performance. It has been suggested that the *personnel* of the enginemen may provide an explanation, or that at some stage of its history it has received an excessive strain of some kind, developing a weakness which cannot be entirely eradicated. But none of the explanations offered appear to be altogether satisfactory, and in some instances they can be negatived at once. Moreover, it is usually found that an engine which thus obtains a secondary reputation, maintains it at least until it is largely rebuilt, and sometimes to the end, although it may be placed on varied duties and several drivers, including the most capable men, may have charge at different periods of its history.

The second basis of variation in locomotive work is found in driving, and this is a more intelligible aspect of the subject. So long as the human element is concerned in the manipulation of the machine, so long will the results be both good, bad and indifferent. The reasons for variation in driving, however, go far beyond this elementary fact, for it does not by any means follow that the man who gains the most time is the best driver. Driving is a science, and must be considered in relation not only to the observance of, or improvement on schedules.

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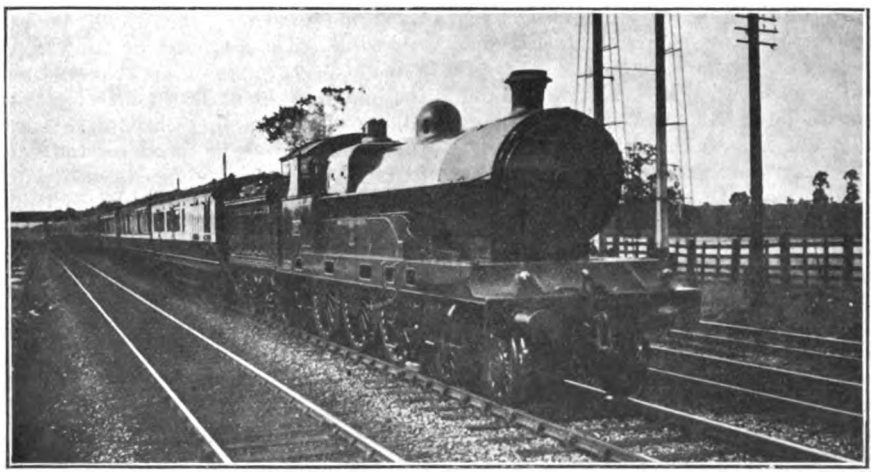
but also to the costs of running and maintenance of the locomotive. There are drivers who will gain time on almost any train, with any load and under any conditions of running; but these results may be achieved at the cost of constantly thrashing the engine, which will entail a heavy consumption of fuel and a frequent bill for repairs. On the other hand a driver may be so careful of his locomotive as never to "extend" it under any circumstances, with the result that any extra load, or spell of bad weather, will mean lost time on the trains of which he has charge. It is on the latter class of run that the observer is sometimes subjected to the peculiarly exasperating experience of losing time while steam is blowing off incessantly throughout the journey. Between these extremes of engine working, therefore, is found the ideal "mean." Those who, as myself, record locomotive running in the public press cannot, of course, always satisfy themselves that the drivers who achieve the most sensational times are the men who are the most careful of the machines under their charge, but it is a well-established fact that the best timekeepers among express drivers are almost always the best drivers in every sense of the word.

Driving is, as has just been said, a science, and does not by any means simply consist in opening the regulator to start the train, and applying the brake to stop it. The successful management of an engine consists in so manipulating the regulator and the reversing gear—the first operation controlling the supply of steam to the cylinders and the second the degree in which it is allowed to expand in them—that every ounce of steam is used to the best advantage. Needless to say, successful driving is intimately bound up with successful firing, and both, again, are ruled by the character of the road traversed. Between the fireman and the driver of an express locomotive there exists a tacit understanding, the fireman knowing exactly how and when to attend to his fire so that the driver has the requisite supply of steam when he needs it, and so that a minimum of steam runs to waste through the safety-valves when the "pulling" becomes easier. It is very evident that shovelling coal on to the fire haphazard at stated intervals will not achieve results of this sort. Successful firing entails an intimate knowledge of the road, and of the exact demands that will be made on the boiler at every stage of the journey. Of course there are circumstances that will render the best of driving and firing ineffective, as, for example, a supply of poor coal, or leaky boiler tubes and other minor defects, under which disabilities it may be impossible to keep time. Sufficient credit is not always given to the firemen by writers on locomotive performance—myself, I fear, included—for their share in locomotive achievements, seeing that the finest driver is absolutely dependent in the accomplishment of these results on the skill of his fireman.



Photo] [*W. H. Kelland.*

UP LIVERPOOL EXPRESS: LONDON AND NORTH WESTERN RAILWAY.

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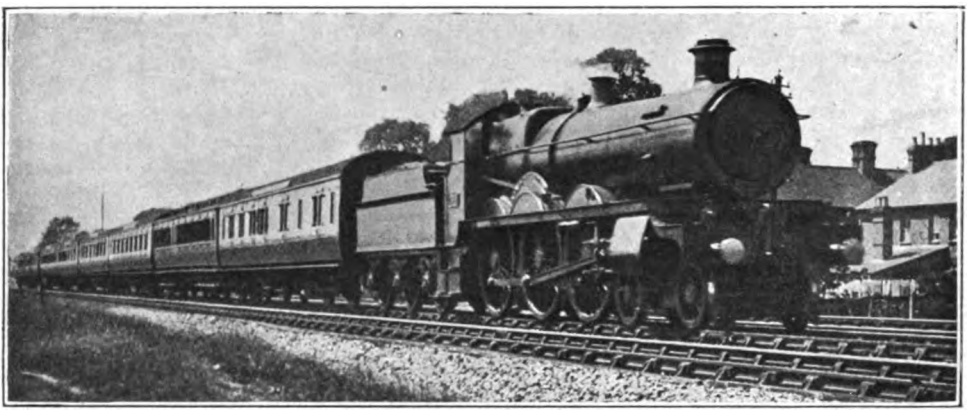

Photo] [*Rev. A. H. Storey.*

GREAT WESTERN RAILWAY.

10.0 a.m. Cardiff-London Express. 4-6-0 locomotive No. 2951, *Tavistock Court.*

But these are not the only factors in timekeeping. The vast majority of drivers might obviously be expected to keep time under normal conditions of running—calm weather, normal load and an absence of checks—on all but the very fastest schedules. It is the abnormal condition, however, that marks out the good time-keeper from those whose work cannot be described by any other term than "mediocre." These abnormal conditions divide themselves into three classes. There are, first, such hindrances as breakdowns, fog, or falling snow, which effectually prevent any attempt to keep time. In the next class we have excessive loads and rough weather, the latter referring more especially to bad side-winds. One driver will do his best, by "extending" his engine a little more than usual, to cope with these exceptional circumstances; another will argue that, if he keeps time under such conditions, he will be setting a precedent that will bind him in the future. In other words, he may be expected to be able to cope at all times with the difficulties of load or weather that he has successfully overcome on this special occasion.

Lastly, we have the vexed question of delays. These may have occurred before the driver concerned takes charge of the train at all, in which case he has not a fraction of responsibility in connection with them. Or they may occur during the journey, in the shape of signal checks, or of relaying slacks or other engineering cautions, and in this case also he can in no way be held responsible. In either event, the train is running late, and it then becomes of interest to see whether the driver will make any attempt to reduce the arrears or not. The timing enthusiast will, of course, expect time to be regained, and will probably stigmatise the driver as "rotten" if it is not, but we need to examine the matter in a somewhat more impartial spirit. One class of driver will put forward two excuses for not regaining time, even though it may be well within his power to do so. The first is that, if he shows his ability to regain the arrears, it will mean that the schedule of the train in question is likely to be curtailed in future by a corresponding number of minutes.

The second reason put forward for not regaining arrears is that, if any untoward incident were to occur while the driver was "making up time," he would be held responsible. This, it must be confessed, is in some respects an unanswerable argument. If the making up of lost time, for instance, consisted in running through stations, or round curves where speed restrictions were in force, at excessive speed, with danger of derailment, the driver would very rightly be held responsible, and no sane person would encourage any such practice. But on a well-aligned modern track, laid in the substantial British manner that has no equal the world over, in the open country there is no danger in the highest speeds of which the steam locomotive is capable. The maximum speeds of 70 and 80 miles per hour constantly recorded in these columns, and even of 90 miles per hour occasionally mentioned, afford ample proof of this fact. Consequently there are but few, if any, lines on which the regaining of lost time is actively discouraged,

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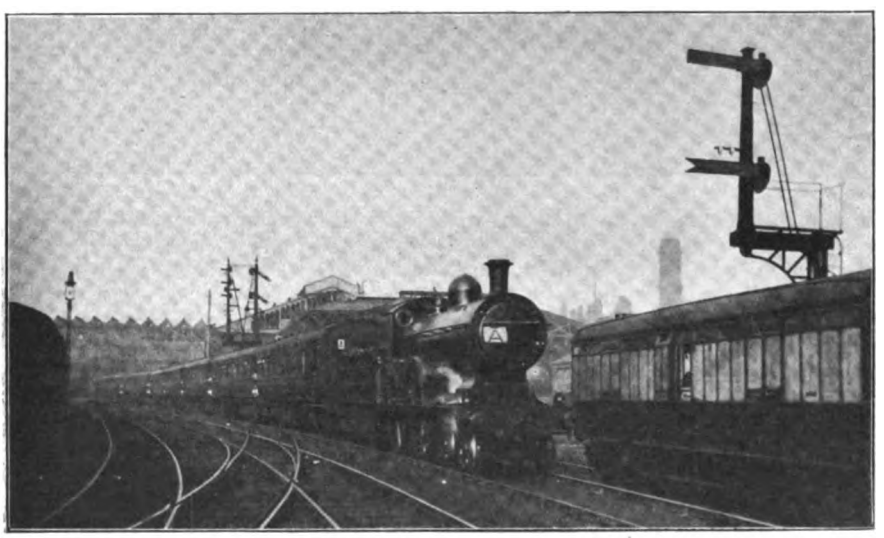
while there are at least two or three on which the almost uniform attempt on the part of drivers to make good their delays proclaims the fact that the practice is, if not openly, at least tacitly encouraged in official quarters. From the public point of view, of course, it is eminently desirable that this should be so, seeing that the published time tables are expressive of a certain duty to the public—timekeeping—if this is reasonably possible, and consistent with safety in running. In this connection it is interesting to note that no serious railway accident during the last decade—with the exception of the Salisbury smash in 1906—has been attributed directly to making up time, even in such cases of derailment through excessive speed as Grantham and Shrewsbury.

The argument that there is danger in regaining lost time cannot, moreover, be logically advanced unless the train in question has the fastest booking for that section of line. In short, such an argument as regards any one train would condemn any train on a faster schedule as running at a dangerously high speed. Further, drivers themselves are not always consistent. I know several men who but rarely gain any time from start to stop under any conditions of running, and who yet think nothing of losing time consistently uphill and regaining it equally consistently by very high speed on the next subsequent descent. As another example of inconsistency—and this is a further source of peculiar exasperation to anyone recording locomotive work—some drivers will start a run in really brilliant fashion, and then, as though realising that they are gaining a little on time, they will deliberately "ease down," in some cases to speeds that are positively ridiculous, in order not to show any gain at the end of the run. I refer, of course, to runs on which the start is behind time.

As an example of consistently attempting to recover lost time I will instance another run on the London and North Western Railway, on an entirely different route to those described in the last issue, which I have recorded since writing the article in question. On this occasion our departure from Liverpool on the 6 p.m. cross-country express for Leeds and Newcastle was delayed for 40 min., owing to some carriages having become buffer-locked outside Lime Street Station. The engine was No. 2584, of the original "Precursor" type, and the driver Ainsworth, of Leeds; the load was light, consisting only of six non-corridor eight-wheelers, totalling 155 tons behind the tender. Starting smartly, we breasted the steep incline to Edge Hill, 1⅜ miles, in 4 min. 25 sec., but were here badly checked by signals, so that the ensuing 2¼ miles to Broad Green took 3½ min. On the level stretch beyond, however, our speed rapidly rose to



Photo] [*G. W. Smith.*

LANCASHIRE AND YORKSHIRE RAILWAY.

Blackpool Express leaving Manchester (Victoria). Rebuilt superheater, 4-4-0 locomotive, No. 1110.

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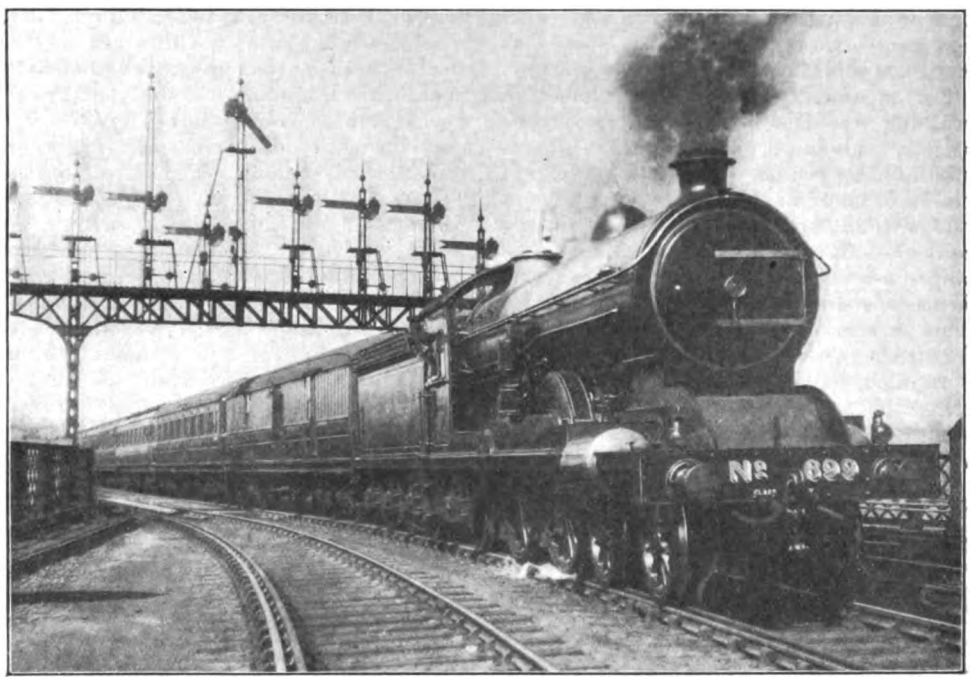
66 miles per hour, and did not drop below 55·6 on the ascent to Rainhill, while in the course of the descent—only 3 miles in length—from Rainhill to St. Helens Junction, it actually rose from this figure to 78·9 miles per hour. So the 5⅜ miles from Broad Green to Rainhill took 5 min. 20 sec., and the 3 miles thence to St. Helen's Junction, 2 min. 40 sec. Unfortunately, a bad check supervened at Earlestown Junction, but the way in which the engine recovered from this delay was remarkable, as four miles later we were again running on the level at 68·1 miles per hour. Our time from St. Helens Junction to Earlestown Junction, 2⅞ miles, was 2¾ min.; from Earlestown to Kenyon Junction, 4 miles, 4¼ min., despite the check; from the latter point to Eccles, 8¾ miles, 7¾ min.; and from Eccles into Manchester, 3¾ miles, 5 min. 50 sec. So the total time for the 31⅜ miles from Liverpool to Manchester, inclusive of the two signal checks and a finish from Cross Lane a minute slower than shown in the working book, was 36½ min., instead of the 38 min. allowed. Allowing for the first two, but not the last delay, the net time was 34 min.—a gain of 4 min. to the engine.

Continuing from Manchester, driver Ainsworth further endeavoured to regain the arrears, although a number of checks rendered this a somewhat thankless task. The very steep ascent of 1½ miles to Miles Platting, partly at 1 in 49, despite a perceptible signal check near the summit, occupied 5¼ min.; after this the further 5¼ miles' ascent to Ashton took 7 min. 10 sec., and the 1½ miles on to Stalybridge 2 min. 10 sec. At the cross-over road from the Lancashire and Yorkshire to the London and North Western line between the two latter stations we slacked carefully as usual. From Stalybridge to Diggle we took the longer Friezland route, only falling on the steepest part of the climb to a minimum of 39·1 miles per hour; the time for the 7¼ miles between Stalybridge and Diggle was 11 min. 20 sec. From Diggle to Marsden, through Standedge Tunnel, the 3¾ miles took 5 min., and from Marsden, passed at a moderate speed, we ran to Huddersfield, 7 miles, in 10 min. 20 sec. But this included a very careful downhill speed, in addition to a serious check outside Huddersfield, so that, although the gross time from Manchester, 26 miles, was



Photo] [*R. J. Purves.*

UP ANGLO-SCOTTISH EXPRESS (10 A.M. *ex*-EDINBURGH) LEAVING KING EDWARD BRIDGE, NEWCASTLE-ON-TYNE.

Ordinary 4-4-2 locomotive No. 699.

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41 min. 15 sec., the net time did not exceed 38 min. The booking of 43 min. again showed 5 min. to the credit of the engine. From Huddersfield we started very smartly, passing Bradley, 2¾ miles, in 4½ min., but, on joining the Lancashire and Yorkshire line, we were practically brought to a stand outside Mirfield, taking 4 min. for the 2¼ miles from Bradley, and 4¾ min. for the ensuing 3 miles to Dewsbury. But we ran well up the 1 in 130-140 to Morley Tunnel, not dropping below 36 miles per hour, and so covered the 4½ miles from Dewsbury to Morley in 8 min. 5 sec., and the final 4¾ miles into Leeds, including a further signal check, in 7 min. 20 sec. The gross time for the 17¼ miles from Huddersfield to Leeds was 28 min. 40 sec., but not more than 25 min. net, allowing for the two checks, showing a gain of 6 min. to the engine. Inclusive of delays, therefore, Ainsworth had gained 5 min. 35 sec., while allowing for the six severe signal checks, his total gain was no less than 15 min. It will be noticed that, although delay succeeded delay, at no time was the effort to make up arrears relaxed, although the route is, in view of its fearsome gradients and chronic signal checks, a truly heartbreaking one for drivers.

The second similar run that I will cite was one of which details were forwarded me by a correspondent during the course of last summer, made on the 10.35 a.m. Great Western express from Paddington to Ilfracombe and Minehead. On this occasion a delay was experienced on starting similar to that on the last-mentioned run, in that some coaches were off the road at Paddington ; as a result, the start was 20 min. behind time. This arrears driver Rolfe, on the four-cylinder 4–6–0 engine No. 4031, *Queen Mary*, at once set out to make up, and as the load was only 270 tons (210 tons beyond Westbury) the circumstances were very favourable. Just before reaching Acton a bad signal check was experienced, which almost brought the train to a standstill, so that it took 15 min. 5 sec. to pass Southall, 9⅛ miles. But the 9¾ miles on to Slough were covered in 8 min. 35 sec., and the 17½ miles from Slough to Reading in 15 min. 48 sec.—a gain of 1 min. 37 sec. from Southall to Reading. The maximum speed on this stretch was one of 71·5 miles per hour at Twyford. Speed was soon recovered from the Reading slack, and ranged from 62 to 68 miles per hour thence to Hungerford—an appreciably rising grade throughout—while the minimum speed up the rise of 1 in 180 and 1 in 141 to Savernake was 52 miles per hour. So the 17⅛ miles from Reading to Newbury were covered in 17 min. 44 sec., and the 17 miles thence to Savernake in 16¾ min.—a further gain of 2 min. 1 sec. on schedule. High speed ensued on the subsequent descent to Westbury, with a maximum rate of 85·3 miles per hour ; in fact, the 16 miles 6 chains from Pewsey to Edington only occupied 12 min. 11 sec., at an average of 79·2 miles per hour. This gave a time of exactly 21 min. for the 25½ miles from Savernake to Westbury, where the usual slack was rigorously made, and the slip detached. A very rapid recovery led to the ensuing 5¾ miles to Frome stop being covered in 6 min. 25 sec. The gross time from Paddington to Frome was thus almost exactly "even"—101 min. 22 sec. for 101⅜ miles—but, allowing the schedule time from Paddington to Southall, whence 9 min. 53 sec. had been gained, the net time from London was 97 min. 17 sec. for this portion of the journey.

The booked stop of 4 min. at Frome was curtailed by 35 sec., and another remarkable effort followed. Witham, 4⅝ miles, was passed in 7 min. 12 sec. (my correspondent unfortunately omitted to record the time at "mile-post 122¾" summit) and the 28¼ miles from Witham to Athelney only occupied 24 min. 28 sec., the maximum speed near Castle Cary being again high—86·7 miles per hour. Unfortunately, a check beyond Athelney was succeeded by a series of checks and a stop just outside Taunton station, so that the 8½ miles to the stop in question took 11 min. 13 sec Even inclusive of these checks the start-to-stop time from Frome to Taunton was only 42 min. 53 sec. for the 41½ miles journey, this alone showing a gain on schedule of 6 min. 7 sec. The net time, however, may be taken as not more than 40¼ min., and Driver Rolfe had therefore performed the astonishing feat of gaining in all fully 18½ min. on this none too easy booking from London to Taunton. From London to Taunton, inclusive of all delays and the Frome stop of 3 min. 25 sec., the *gross* time was only 147 min. 40 sec., or less than the passing time at Taunton of non-stop expresses from London ; the actual running time was 144¼ min. for the 142⅞ miles. For net times 7 min. must be deducted from this figure—a little over 4 min. for Acton slack, and a little under 3 min. for those at the conclusion of the run. It is worthy of note that this time-regaining exploit included two consecutive runs made in under "even time"—from Paddington

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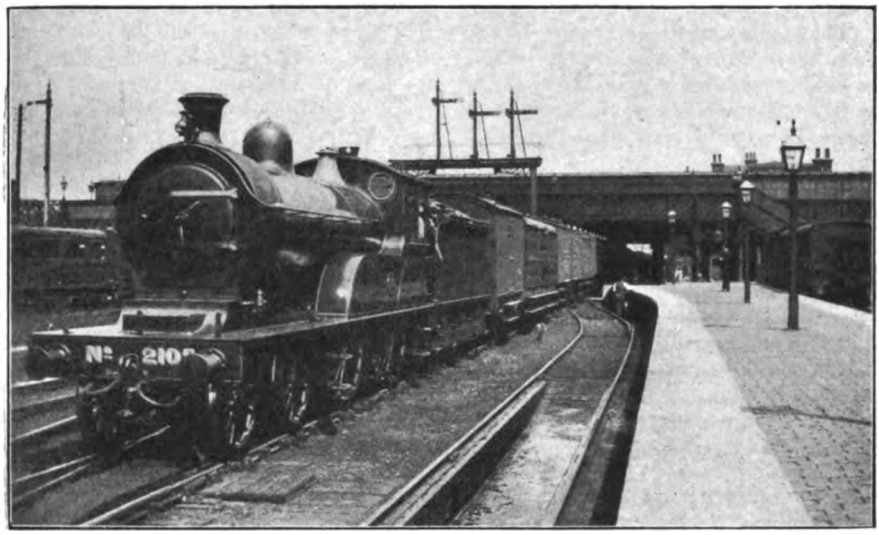

Photo] [*G. A. Benn.*

NORTH EASTERN RAILWAY.

No. 2105 (Class R) at Doncaster, Great Northern Railway.

to passing Westbury, 95⅝ miles in 94 min. 57 sec. (including the slack at Acton), and from Frome start to Athelney, 32⅞ miles in 31 min. 40 sec.

For a plucky fight against delays, however, a run that I made recently on the up "Bath Spa" express would, I think, take some beating. The engine in this case was No. 2946, *Langford Court*, a 2-cylinder 4-6-0 and the load a fairly moderate one of 240 tons from Bristol, 270 tons from Bath, and 245 tons beyond Reading. We started by running from Bristol to Bath, 11¾ miles, in the smart time of 14¾ min., with a maximum speed of 62·5 miles per hour beyond Saltford. From Bath, with an allowance of 115 min. for the 106¾ miles to London, we started briskly, covering the 5 miles to Box in 7¾ min., and attaining there a speed of 60 miles per hour. But our first check occurred in the Box Tunnel, through almost the whole of which permanent way repairs entailed a veritable "crawl," so that the 3½ miles from Box to Corsham consumed no less than 7 min. 25 sec. Regaining speed very smartly, we passed Chippenham, 4¼ miles from Corsham, in a further 4½ min., and covered the 6¼ miles on to Dauntsey in 5 min. 20 sec., attaining a maximum speed of 71·4 miles per hour on this short length of level track. Our speed did not fall below 55 miles per hour up the 1 in 100 of Dauntsey bank, and we were again accelerating, when we were pulled up dead slow for signals at Wootton Bassett. So the 4¾ miles from Dauntsey to Wootton Bassett took 5¾ min., and the 5¾ miles on to Swindon 6 min. 40 sec. At this point, most regrettably, owing, I suppose, to the heat of the day, I have to confess to falling asleep! My next conscious moment was on passing Shrivenham, 5¾ miles beyond, which we did 6 min. later. I do not know whether any check was experienced on this length, the speed over which seems a little slower than usual.

But now a remarkable effort was made, speed rising to a steady 73·8 miles per hour at Challow, 75 at Wantage Road, and a sustained 77·5 between Steventon and Didcot. The 5 miles from Shrivenham to Uffington took 4¾ min.; the 6 miles from Uffington to Wantage Road 4 min. 50 sec.; and the 7½ miles from Wantage Road to Didcot 5¾ min. As the grade here is nowhere steeper than about 1 in 660, this was really first-class work, and, despite the two bad delays, our time for the 53¾ miles from Bath to Didcot was only 59¾ min. The net time from Bath to this point I should calculate as exactly "even"—53¾ min. Now, unfortunately, there ensued a whole string of checks, culminating in a stop at Reading to detach the slip-coach, the 17 miles from Didcot to Reading stop taking no less than 21 min. 5 sec. Once again a brilliant effort followed. Twyford, 5 miles from the start,

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was passed in 6 min. 40 sec., at 67 miles per hour; Maidenhead, 11¾ miles, in 12¼ min. at 73·8; and shortly afterwards, on a practically dead level track, the speed rose to 75 miles per hour, and was maintained at this astonishing figure for between 6 and 7 miles. Continuing with the times from the start, Slough, 17½ miles, was passed in 16 min. 55 sec., and West Drayton, 22¾ miles, in 21¼ min.; after this there was a pronounced "easing," Southall, 27 miles, being passed in 25 min. 10 sec., Acton, 31¾ miles, in 30 min. 5 sec., and Westbourne Park, 34¾ miles, in 33 min. 50 sec. Our first slight check occurred beyond Southall, a second, fairly severe, followed at Acton, and we were then brought to a dead stand at Royal Oak, 35½ miles from Reading, in 35 min. 40 sec. from the Reading start. A clear road into Paddington would probably have given a run in under "even time" from Reading to Paddington. Finally, 2 min. 20 sec after stopping (momentarily) at Royal Oak, we pulled up in Paddington platform, having taken a total time of 120¾ min., and an actual running time of 118½ min. for the 106¾ miles from Bath to London.

Now the gross time was 5¾ min. over schedule, but let us reckon of what delays it was inclusive. There was first the Box Tunnel check, costing fully 3½ min., and then the signal delay at Wootton Bassett, worth 2 min. Judging by the speed at which we approached Didcot, the allowance for the succession of checks between there and Reading and the Reading stop cannot be less than 10 min., while for the delays and the stop approaching Paddington at least 3¼ min. must be allowed. Consequently our net time was some 102 min. for the 106¾ miles journey, start-to-stop—a gain of 13 min. on booked time. Doubtless the remarkable speeds of this trip would not have been run had it not been for all the delays encountered, but I do not doubt for a moment that our driver would have regained completely the first two delays and a late start of 3 min. from Bath had we had a clear road beyond Didcot. The splendid effort beyond Slough proved that the driver was proof against the disheartenment occasioned by a series of checks such as we experienced on this run. Regaining of lost time may not be encouraged by some companies, but there is no question that the driver who is willing and ready, under all adverse circumstances, to "do his best" commands the greatest respect, both on the part of his superiors and on that of the travelling public. I have very much more to say on this interesting subject, but consideration of the question of excessive loads and of hill-climbing traditions and practice must be deferred until the next issue.

Photo] [*J. Cheyne.*

NORTH BRITISH RAILWAY.

9.30 a.m. Edinburgh-Aberdeen express passing Broughty Ferry. 4-4-2 locomotive No. 878, *Hazeldean.*

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THE RAILWAY PORTRAIT GALLERY.

MR. CYRIL F. BENGOUGH, M.Inst.C.E.,

Chief Engineer, North Eastern Railway.

As announced last month, in succession to Mr. C. A. Harrison, Mr. Cyril F. Bengough, M.Inst.C.E., Chief Engineer, Southern Division, has been appointed Chief Engineer for the whole of the North Eastern Railway system. Mr. Bengough was born in 1864. He was educated at Marlborough College and University College, Bristol, where he passed through the Engineering Course. In 1885 he became an articled pupil of the late Mr. P. J. Messent, M.Inst.C.E., Engineer to the River Tyne Commissioners, and remained in the service of the Commissioners until 1890. In that year he was appointed Resident Engineer in charge of construction of the Annfield Plain and Team Valley Branches of the North Eastern Railway, under Mr. Chas. A. Harrison. In 1899 he was appointed District Engineer in charge of the Bishop Auckland District. In 1906 he was transferred to Newcastle as District Engineer in charge of the Newcastle District, and in 1909 was appointed Engineer for the Southern Division, with headquarters at York, in succession to the late Mr. W. J. Cudworth. In 1912 Mr. Bengough took charge of the maintenance of the whole of the lines, in addition to the new works on the Southern Division.

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Photo] *[G. Marshall Smith.*

BOOKING HALL: KILBURN PARK STATION.

To Queen's Park via the London Electric Railway.

THE Queen's Park extension of the "Bakerloo" section of the London Electric Railway has already been fully described (see the RAILWAY MAGAZINE for December, 1914), so that brief reference only is necessary to its virtual completion and opening for traffic. Owing to the influence of the war, in delaying the supply of material and in obtaining labour, combined with difficulties at the Queen's Park end occasioned by the long spell of exceptionally wet weather, the inauguration of public traffic has had to be postponed several times, but on Sunday, January 31st trains commenced running through, though even then they could only convey passengers as far as Kilburn Park, the completion of the platforms and platform buildings at Queen's Park rendering it inadvisable to bring them into use until February 11th.

The importance of this connecting link between South and Central London and the London and North Western system has yet to be revealed, but when the London and North Western electrification works are completed, and trains can run through between the Elephant and Castle and Watford there is little doubt that this, already one of the busiest tube lines, will become one of the main lines of communication in the metropolis.

There are three stations on the new line, the first being situated beneath the broad roadway facing St. Saviour's Church in Warwick Avenue, after which thoroughfare it is named; the second, Maida Vale, is at the junction of Portsdown Road with Elgin Avenue, about a hundred yards off the Edgware Road; while the third, Kilburn Park, is in Cambridge Avenue, near the Kilburn station of the London and North Western Railway.

All three of the new stations embody the latest features of Underground station design. At Warwick Avenue there is no superstructure, short flights of stairs leading down from the pavements to a spacious booking hall below the roadway. At Maida Vale and Kilburn Park the booking halls are on street level. Lifts are entirely dispensed with, escalators providing the means

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of communication between the booking halls and the platforms below. Each set of escalators works on either side of a stationary staircase, and the lower landing being within a few feet of the platforms, passengers are able to make the journey between the latter and the street with the utmost facility and convenience.

It is claimed that Kilburn Park is the finest station on the Underground system. It certainly justifies a good deal of enthusiasm, from the æsthetic standpoint, on behalf of the surface buildings. A new motor-'bus service between Kilburn Park and Hendon has been inaugurated.

Between Kilburn Park and Queen's Park the new line emerges from the tunnel, and, for the last quarter of a mile of its course, runs in the open alongside the London and North Western Railway, with which it finally connects. At Queen's Park the "Bakerloo" lines come between two islands, the down platform receiving at its outer face what will be the London and North Western Railway down electric lines, while the up line platform will also serve the London and North Western Railway up electric line, thus facilitating interchange of passengers. Beyond the platform the "Bakerloo" lines pass through a car-shed, so that these lines can be used for stabling trains at night, and connect beyond with the London and North Western Railway electric lines.

Electrical energy for the Underground extension is supplied from a new sub-station adjoining Kilburn Park station, and two new car-sheds for the accommodation of the "Bakerloo" rolling stock have been erected at Queen's Park. Altogether the extension will have entailed an expenditure on the part of the London Electric Railway Company of over three-quarters of a million pounds.

Signalling is automatic and semi-automatic, on the McKenzie, Holland and Westinghouse Power Signal Company's electro-pneumatic system, to accord with that already in use on the "Bakerloo" line, but with alternating current track circuits.

The "Bakerloo" Railway, from its southern terminus at the Elephant and Castle to its new northern extremity, is now about 7 miles in length, while the distance from the former point to Watford is 20¾ miles. Owing to the station at Maida Vale not being in such an advanced stage of construction as are the others on the new line, the former will not be used for traffic until a later date, so that for the time being trains run direct from Warwick Avenue to Kilburn Park. A 2-min. service will be maintained over the "Bakerloo" line during the busy periods of the day, while it is anticipated that four trains hourly will eventually run through to Watford, the journey being accomplished in about 60 min.

On Friday, January 29th, a special inspection was made. For the train four new all-steel cars were used, these being the Leeds Forge-built cars described some time ago in these pages, and including Mr. Agnew's special system of radially-opening doors, with safety indicators under the gatemen's observation. *En route* Warwick Avenue and Kilburn Park stations were inspected.

The guests were subsequently entertained to luncheon at the Great Western Railway Hotel at Paddington, Mr. W. E. Mandelick, in the absence of Sir Albert Stanley, occupying the chair in one room, and Mr. S. J. Webb, passenger agent, presiding in another. Among others present were: Mr. H. E. Blain, Superintendent of Operation; Mr. Z. E. Knapp, Manager for Construction and Maintenance; Mr. W. E. Blake, Superintendent of the Line; Mr. J. P. Thomas, General Superintendent, London General Omnibus Company; Mr. W. A. Agnew, Chief Mechanical Engineer; Mr. P. V. McMahon, Chief Engineer, City and South London Railway; and Messrs. A. Feiron and A. F. Bradford, representing the London and North Western Railway.

Mr. W. E. Mandelick mentioned that the people of Maida Vale had often written to the Company in the last few years in order to endeavour to get them to make arrangements whereby a railway could be built to bring them from Maida Vale to the heart of London, owing to the fact that the inhabitants were not in favour of running trams along the Edgware Road. The extension would serve this purpose, as one could travel from Elephant and Castle to Queen's Park in 25 min. Warwick Avenue would serve a district by which a good many people would come to Oxford Circus and Piccadilly; Kilburn Park was in a district which would serve the Maida Vale people, and the station there would be a great convenience.

Finally, there is the advantage of through running in conjunction with the London and North Western Railway, and it is hoped that this will be arranged at a comparatively early date.

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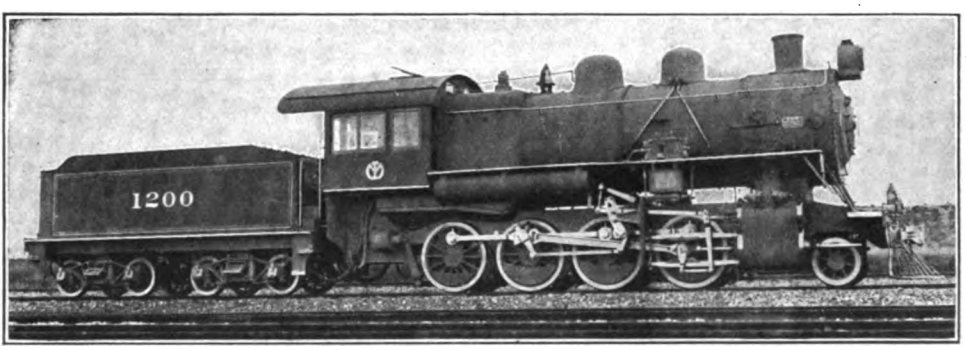
A New Epoch in Japanese Engineering.

THE FIRST STANDARD GAUGE LOCOMOTIVE, DESIGNED AND BUILT AT THE SOUTH MANCHURIAN RAILWAY WORKSHOPS.

By H. J. MULLETT-MERRICK.

ON Friday, October 30th, 1914, a trial trip was successfully made on the main line of the South Manchuria Railway, of a new locomotive, which event marked a new epoch in the annals of Japanese railway engineering. On the Imperial Japanese Government Railways home-built locomotives are drawing Imperial Government trains, but all the Japanese home lines are on the narrow gauge. This one, whose trial trip Dairen had the honour of witnessing, is the first standard gauge locomotive ever designed and built by Japanese engineers, at the workshops of the South Manchuria Railway at Shakako, near Dairen, the terminus and headquarters of the Railway, and one of the most flourishing ports in the Far East.



2-8-0 SUPERHEATER LOCOMOTIVE: SOUTH MANCHURIA RAILWAY.

The lay-out of the Shakako Workshops, though on a comparatively small scale, is one of the best and most up-to-date in the world, and the equipment is second to none. Opened only in 1911, with the most modern facilities and machinery that science had invented, nothing has yet become obsolete or old-fashioned, while new inventions and facilities are added whenever they appear. There are nearly 3,000 well-trained employees, the majority of whom live in a model town adjoining.

Having produced some of the most beautiful saloon carriages and passenger cars in the world, as well as goods cars of every description, tram cars, etc., and having, in addition, put out at short notice much machinery, such as huge winding machines for use in the Company's coal mines, etc., Mr. H. Mori, formerly Superintendent of the Workshops of the Imperial Japanese Government Railways, has now turned his attention to the construction of locomotive engines.

Hitherto the South Manchuria Railway trains have been hauled by locomotives purchased in America and Great Britain. But this home product has entirely justified itself. It is of entirely new design, and embodies the merits of the best types in Europe and America, adapted to suit the condition of the Company's lines.

The Workshops are now building five more locomotives of the same design, and are also constructing six double-ender tank

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engines for the Chosen (Korean) Government Railways. Moreover, it is intended to gradually increase the capacity for building new locomotives and cars.

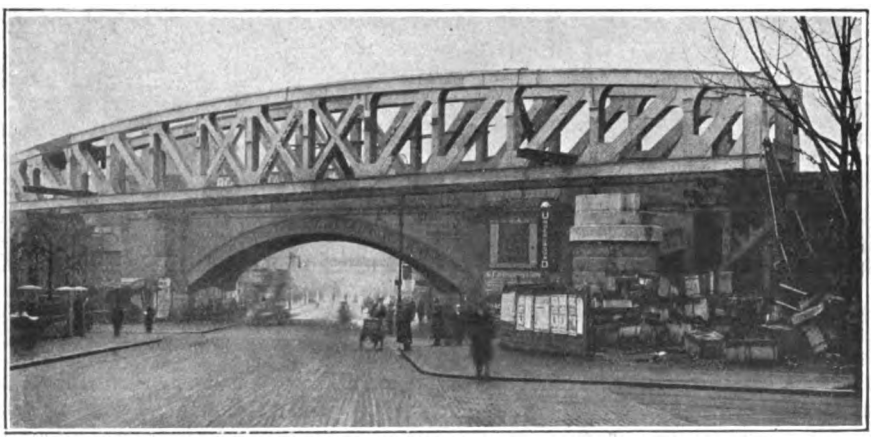
The following is a description of the engine referred to:—

The frames are of plates with under-hung driving springs, similar to the Continental type. The boiler is of the Belpaire type, with cylindrical smoke-box, supported by a saddle made of steel plates, the exhaust pipes in the saddle being of steel. The brick arch is of special re-enforced design, with no arch tube, which has been found, by actual trials already made on several locomotives, to last over seven months without attention. A superheater of the Schmidt type is employed, with a superheater heating surface of 532 sq. ft. Lubrications of the cylinders, steam chests, and air pump are by Michalk's mechanical lubricator. Valve motion is of the ordinary Walschaert type, and the elliptic valve diagram was automatically drawn by actual valve motion, thus ensuring that the steam distributions in the cylinders are perfect.

Principal dimensions and weight distributions of the locomotive are as follow :—

Gauge	4 ft. 8½ in.
Fuel	soft coal
Weight of engine in working order	81¼ tons
Adhesive weight	72½ tons
Wheel base coupled	15 ft. 4 in.
Wheel base, total	23 ft. 8½ in.
Wheel base, engine and tender ..	53 ft. 5½ in.
Cylinders	22½ × 28 in.
Coupled wheels, driving, diameter over tyres	4 ft. 6 in.
Truck wheels, diameter	2 ft. 9 in.
Working pressure	180 lbs.
Heating surface, tubes and flues ..	2,367 sq. ft.
Heating surface, fire box	182 sq. ft.
Heating surface, total	2,549 sq. ft.
Superheater heating surface ..	532 sq. ft.
Grate area	49 sq. ft.

A NOTABLE ENGINEERING FEAT ON THE METROPOLITAN RAILWAY.



NOTWITHSTANDING the War the Metropolitan Railway has been proceeding steadily with the work of four-tracking the Finchley Road—Wembley Park section of the Extension Line. Particulars have already been given of the general features of this work, and we now reproduce an interesting view showing the main girders of the largest bridge, that over High Road, Kilburn, placed in position recently with a minimum interference to the street traffic below. The progress of the work attracted immense crowds, for with its weight of 600 tons and length of over 200 feet, it presented an impressive engineering feat of considerable magnitude. The completion of this link will bring London nearer to the Herts and Bucks country, as an additional new and fast service of trains will be brought into operation from the 1st of May.

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Locomotive and Train Working in the latter part of the 19th Century.

LONDON AND NORTH WESTERN RAILWAY. [No. III.]

By E. L. AHRONS, M.I.Mech.E., M.Inst.Loco.Eng.

IT is now time to say something of that numerous class of express engines—the Ramsbottom 6 ft. 6 in. coupled or "Newton" class. The first batch of them was built early in 1866, to run the Scotch expresses between Crewe and Carlisle, where coupled engines were needed. The cylinders were 17 in. by 24 in., coupled wheels 6 ft. 7½ in., leading wheels 3 ft. 7½ in. diam. The boiler carried 120 lbs. pressure, and had 1,102 sq. ft. of heating surface, to which the tubes contributed 1,013 sq. ft. and the firebox 89 sq. ft. Their total weight was only 28 tons 13 cwt. in working order. There were several essential points in common with the later "Precedents" and several very marked differences. The cylinders, wheels and wheelbase were the same. The "Precedents" had larger boilers, but nevertheless the Ramsbottom's had more heating surface, but this was tube surface only, for the firebox heating surfaces were in the ratio of 103½ sq. ft. for the "Precedent" to 89 sq. ft. for the Ramsbottom, and the grates were as 17·14 to 14·95 sq. ft. in area. The Ramsbottom carried in the early days 120 lbs. pressure, but later 140 lbs. The motion was also entirely different. Ramsbottom's engines all had Stephenson's link motion, but the "Precedents" had Allan's straight link motion.

There were 96 of the "Newton" class, of which the 76 engines built between 1866 and 1871 originally had Ramsbottom's ornamental chimneys with pieces cut out of the caps, the well-known oval apertures in the splashers, but no cabs. Mr. Webb constructed 20 more at Crewe in 1872-3, in which the modern form of Webb's chimney and cab was added. The first of the class, No. 1480 *Newton*, was the first engine to be fitted with circular bushes for the coupling rods, and the second, 1481 *The Duke of Edinburgh*, was named in honour of a visit of the late Duke to Crewe early in 1866.

In 1878 to 1882 their appearance was considerably altered. They were reboilered with boilers carrying 140 lbs. pressure and new splashers were substituted, which made them outwardly almost resemble the "Precedents." They could, however, be distinguished by their somewhat smaller boilers and longer chimneys. They were distributed as follows, but many of them were constantly changed from one station to another.

Rugby had four or five, which occasionally ran up to London, but usually northwards. On one turn they worked the newspaper express through to Manchester, and returned with an express in the afternoon from Manchester. The three or four at Birmingham which ran regularly to London have already been mentioned. Crewe with about 25 of the class, Manchester with 25, and Liverpool with about 20, accounted for most of them, but Chester and Llandudno had 8 or 10, Preston half-a-dozen, and Carlisle three or four. There were also two at Shrewsbury, with which through trains to Manchester were worked. Prior to 1874 they almost monopolised the service between Crewe and Carlisle, but in that year the 5 ft. 6 in. "Precursors" appeared and took their places. Nevertheless they were to be frequently seen on the Carlisle road on stopping and semi-fast trains for many years afterwards. The Crewe engines ran on all the various lines radiating from that place, the Chester engines worked between there and Holyhead and also to Manchester. The Llandudno engine was generally 974 *Richard Cobden*, which secured a monopoly of that seaside shed. The Manchester (Longsight) engines worked to Shrewsbury and Leeds, and I believe had one turn to Rugby, whilst the Manchester (Ordsall Lane) engines ran to Liverpool, Windermere, Leeds, and Llandudno. Many of the trains on the Leeds section were worked by the Liverpool "Ramsbottom's," four or five of

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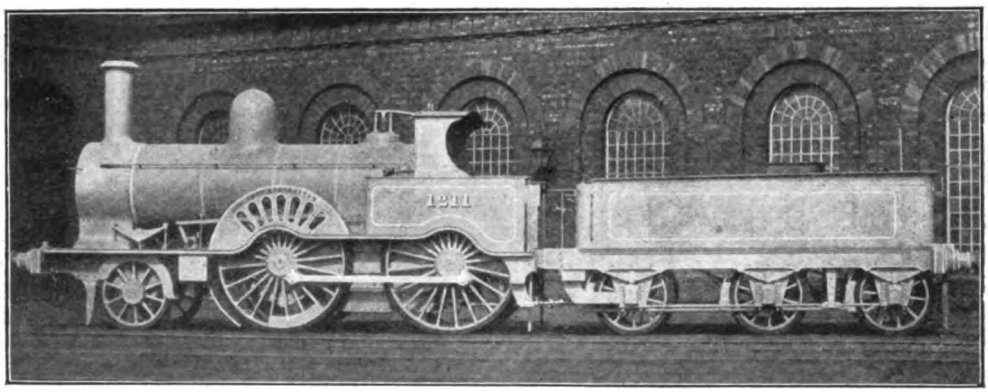
which went to Leeds daily. Crewe engines of the same class had also one turn to Leeds in the morning, returning thence at 1 p.m. Nos. 1211 to 1220, stationed at Crewe, were usually on this turn. All other trains not worked by Leeds "Precursors" were in the hands of the Manchester "Ramsbottom's," for there were none stationed at Leeds.

For the period (1866) when they were originally designed they were excellent engines, but afterwards they were too light for the increasing weight of trains. My own experiences with them chiefly between Manchester and Leeds, and Manchester and Crewe proved that they were good average engines, without any claims to brilliance. My best recorded run was with 394 *Eamont* from Stockport to Crewe with 9 coaches. The 25¼ miles were covered in 30 min. 25 sec., almost 50 miles per hour. On the Leeds road the service was so bad that the recording of speeds was not worth troubling about. But more of the Leeds road later, as also of the renewals of the "Newton" class.

Between 1874 and 1877 the greater part of the Scotch expresses between Crewe and Carlisle were run by Mr. Webb's 5 ft. 6 in. "Precursors." These engines were very rarely to be seen south of Crewe. Practically they were "Precedents" with small wheels, or to put it more accurately, as the "Precursors" antedated the others by a few months, the "Precedents" might have been described as "Precursors" with large wheels. At one period Mr. Webb appeared to be extremely partial to small wheels for express or fast traffic and it was stated at the time that the initial experiments in this direction consisted in the partial removal of the coupling rods of a 5 ft. 2 in. goods engine of the "D.X." class, thus temporarily converting her from a six into a four-coupled engine. The result appeared in the form of the "Precursors." In these engines the cylinders were 17 in. diam. by 24 in. stroke, leading wheels 3 ft. 7½ in. diam., coupled wheels 5 ft. 6½ in. diam. The boiler barrel was the same as that of the "Precedents" and contained 198 1⅞-inch tubes with a heating surface of 980 sq. ft., but the firebox was somewhat smaller and had a heating surface of 94·6 sq. ft. only. The engine weighed 31 tons 8 cwt. in working order, of which 21 tons rested on the coupled wheels. Like the "Precedents" they had Allan's straight link motion. The stations are given as they were in 1880, but these engines frequently changed their location. I believe that almost all of them were quartered at Leeds at one time or another.* No. 1155 *Dragon*, generally a Leeds engine, put in a few months at Shrewsbury on the Hereford line.



NO. 1211, *John Ramsbottom* (1872), 6 FT. 7½ IN. CLASS AS BUILT BY MR. WEBB, AND FITTED WITH CAB.
This was the first passenger engine placed in service by Mr. F. W. Webb.

It may not be generally known (as it is only a matter of outward interest) that the present brass London and North Western Railway number plates date back only to the 1878 engines, ten "Precedents" and ten "Precursors," built in the autumn of that year. In Mr. Ramsbottom's time the numbers were painted on the engines, but Mr. Webb introduced number plates of cast-iron with the numbers painted in yellow. There are still a number of these to be seen on the duplicate engines.

* Except Nos. 2145 to 2149 which were generally at Crewe and Carlisle and passed most of their existence on the Carlisle road.

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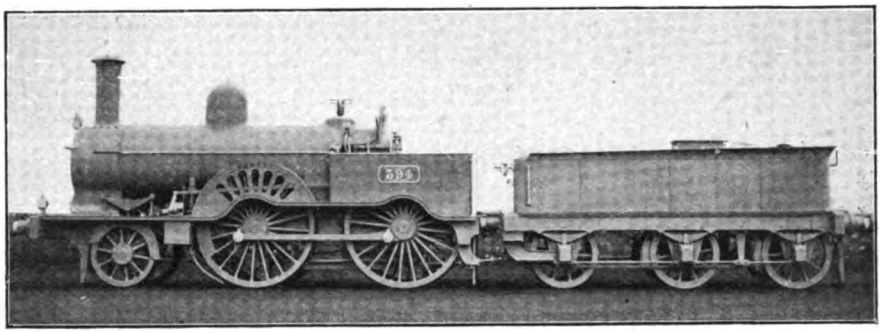


MR. RAMSBOTTOM'S 6 FT. 6 IN. 2-4-0 ENGINE NO. 394 *Eamont*, BUILT IN 1870.

The speed of the 10 a.m. Scotch express from Euston was not heroic. From Crewe to Preston it averaged 46 miles per hour, and Preston to Carlisle, 90 miles over the Westmoreland Hills, required 2 hours 10 min., a running speed of 41½ miles per hour only. In 1877 the railway allowed the passengers half an hour at Preston for dining, but in 1883 coolly knocked off 10 min. and left Preston at 3.10 instead of 3.20, but still took the full 2 hours 10 min. for the run to Carlisle. The Scotch Limited Mail (8.50 p.m. *ex*-Euston) was timed in 1878 as follows:—

LIST OF WEBB'S 5 FT. 6 IN. "PRECURSOR" CLASS.

20 ENGINES BUILT 1874.

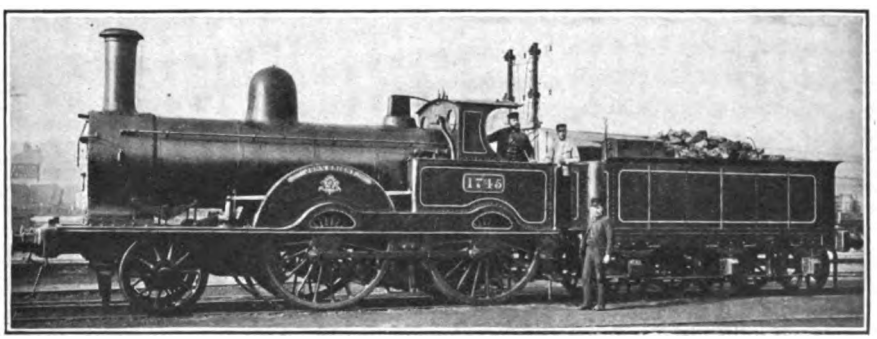
2145	*Precursor*	15
2146	*Harbinger*	15
2147	*Champion*	15
2148	*Vizier*	15
2149	*Candidate*	15
1143	*Marquis*	15
1144	*Druid*	29
1145	*Cossack*	29
1152	*Arab*	17
1153	*Sirocco*	29
1154	*Colossus*	29
1155	*Dragon*	17
402	*Viscount*	17
406	*Senator*	15
408	*Simoon**	15
409	*Thunderbolt*	—
413	*Python*	17
425	*Oberon*	17
426	*Warrior*	17
427	*Fame*	17

20 ENGINES BUILT 1878-1879.

1147	*John Rennie*	19
1148	*Boadicea*	20
1149	*Hellvellyn*	19
1150	*Lang Meg*	17
1151	*Lapwing*	15
1165	*Vulture*	—
1169	*Albatross*	29
1174	*Cerberus*	29
697	*Harrowby*	15
847	*Cedric*	17
255	*Eglinton*	15
338	*Levens*	29
431	*Bessemer*	—
481	*Etna*	15
626	*Emerald*	15
680	*Gifford*	19
718	*Jason*	17
779	*William Baker* ..	19
838	*Henry Cort*	Bangor
1180	*Pearl*	15

15 Crewe 19 Chester
17 Leeds 29 Carlisle

* Name on engine mis-spelt as above.



Photo] [*Loco. Publishing Co.*

NO. 1745 *John Bright*, RAMSBOTTOM 6 FT. 7½ IN. COUPLED ENGINE.

As running 1880-1892 after alteration by Mr. Webb, including closed splashers and cab.

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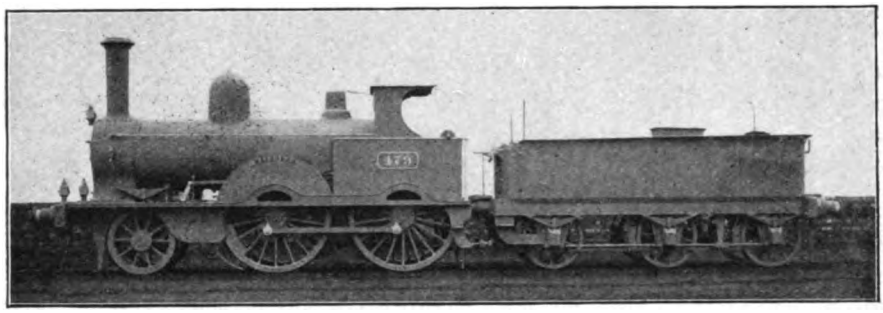
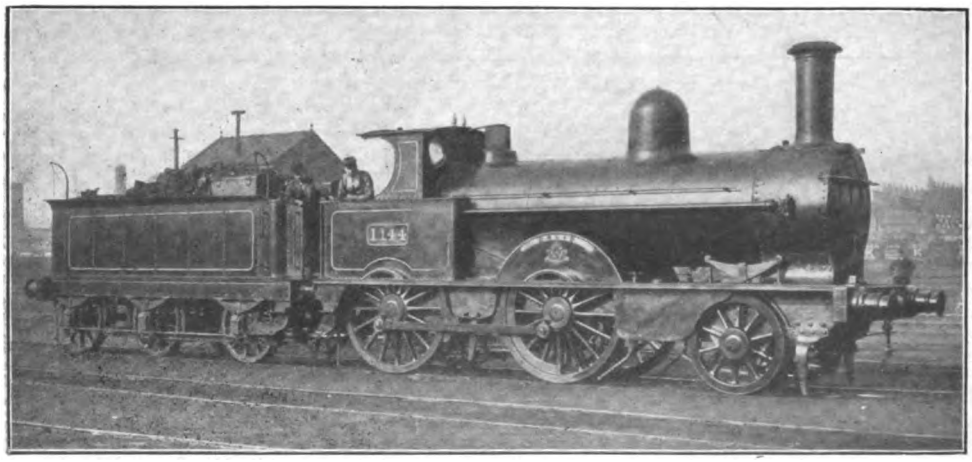


6 FT. 2-4-0 LOCOMOTIVE NO. 479, *Mastodon*.

		Arr. a.m.	Dep. a.m.	Speed. m.p.h.
	Crewe	—	12.38	—
36¼	Wigan	1.24	1.30	45
51¼	Preston	1.51	1.55	42·8
78¼	Carnforth ..	2.34	2.37	41·9
141¼	Carlisle	4.10	—	40·5

The logs of these trains are characteristic of the London and North Western Railway of that period. They would not be worth mentioning, but I do so in order to draw attention to the apparently "mild" results which the "Precursors" gave on them. In August, 1877, after about three years' work, the "Precursors" were taken off the day Scotchman and replaced by a "Precedent." In 1878 there were six "Precedents" on the fastest trains between Crewe and Carlisle, and 6 ft. 6 in. Ramsbottom's were taking one or two of the best of the remaining trains between Crewe and Preston. To the "Precursors" there remained the slow and semi-fast trains, mostly worked from the Carlisle end. I have never quite understood why they failed on the best trains; had the average speeds been 50 to 55 miles per hour it would at least be comprehensible, but to knock themselves to pieces, as they are stated to have done, over the 40 to 43 miles per hour trains seems "passing strange," unless the 45 and 46 miles per hour runs south of Preston were too much for them. They were supposed to climb the banks at such speeds as would save the subsequent downhill rushes indulged in by the 6 ft. 6 in. Ramsbottoms, but I have seen "Precursors" running through Carnforth and Lancaster stations at fully 65 to 70 miles per hour. In 1878 Crewe worked "Precedents" Nos. 857, 858, 860, 1177, 2181 and 2182 regularly over the Carlisle road, and in 1882 they added 262, 264, 265 and 364, all sister engines of the *Charles Dickens*. The up trains were usually piloted from Carlisle to Shap by 6 ft. 6 in. Ramsbottoms, of which one or two were stationed at Carlisle.

Returning now to the North Eastern Division of the London and North Western Railway, a mere passing mention may be



NO. 1144, *Druid*, 5 FT. 6 IN. "PRECURSOR" CLASS OF 1874.

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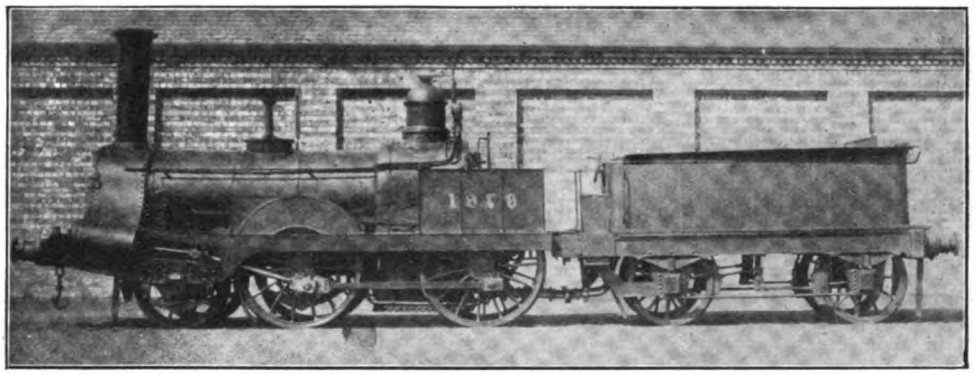
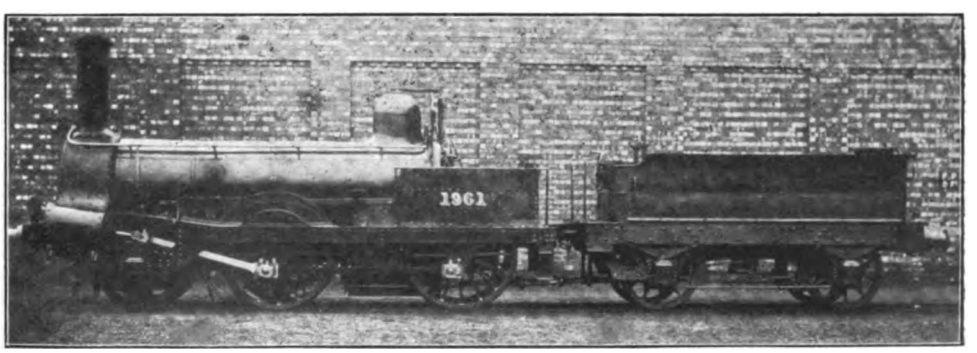


5 FT. 2-4-0 "CREWE GOODS" ENGINE, AS USED IN LEEDS-HUDDERSFIELD PASSENGER SERVICES FOR A CONSIDERABLE PERIOD.

made of the Manchester and Buxton service. Here the gradients are 1 in 58 and 1 in 60 in the Peak, and comparatively fast morning and evening trains for business people had to be run. At one time the 2–4–0 outside cylinder engines with 5 ft. wheels and 16 in. by 20 in. cylinders from the old Lancaster and Carlisle Railway (see below) were used. In 1874–5 before the "Precursors" were sent to Leeds, three or four of them were put to work on the Buxton trains, but eventually in 1876 Mr. Webb's 2233–2252 class of 2–4–0 side tanks with leading radial axles took up the work on this branch. These tank engines had driving wheels only 4 ft. 7½ in. diam. and cylinders 17 in. diam. by 20 in. stroke. Their fastest run was from Buxton to Stockport, 19⅝ miles in 32 min. with 7 six-wheeled coaches.

The "Yorkshire section" between Manchester and Leeds was worked entirely by 6 ft. 6 in. Ramsbottom's from the Lancashire end, and by 5 ft. 6 in. "Precursors" from the Leeds end. This refers to the through trains only, there were other types of engines on the local trains. The faster trains —one cannot call them expresses with any approach to truth—were generally under the charge of the Ramsbottom's. The best train was the 12 noon from Manchester which reached Leeds (42¾ miles) in 1 hour 20 min. with I believe only one stop, viz., Huddersfield. This train produced a startling phenomenon in September, 1880. I have already mentioned Mr. Webb's penchant for small wheels for fast traffic which led to the design of the "Precursors." During the month in question he gratified his taste in this direction by running this—the then fastest train between Manchester and Leeds —with one of the earliest of his new 2–4–2 tank engines, No. 979, with wheels only 4 ft. 7½ in. in diameter. I saw it arrive at Leeds on two occasions a few minutes late, but whether the engine had dropped the time I cannot say.

In 1883 an innovation was made in conjunction with the North Eastern by running the first of the through fast trains between Liverpool and Newcastle. There were two trains in each direction which had to be



NO. 1961, ORIGINALLY NO. 1123 (DATED 1857), ONE OF THE FAIRBAIRN ENGINES BELONGING TO THE LANCASTER AND CARLISLE RAILWAY.

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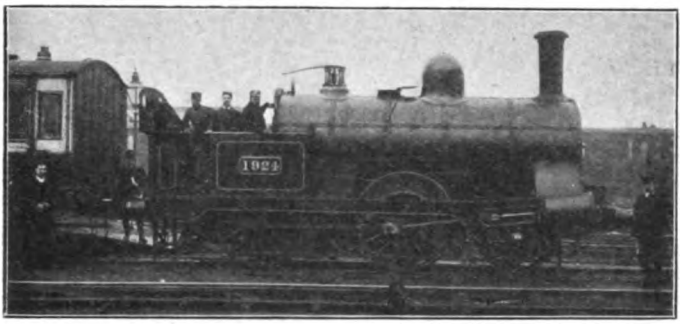


Photo] [*Loco Publishing Co., Ltd.*

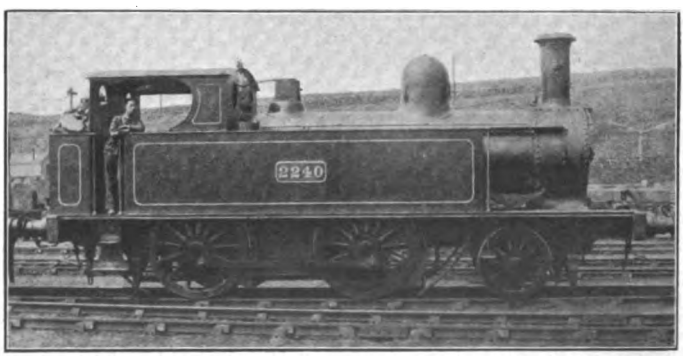
2-4-0 SADDLE TANK ENGINE (504 CLASS), "CREWE GOODS" ENGINE, REBUILT BY MR. RAMSBOTTOM.

fitted with both vacuum and Westinghouse brakes. Over the North Western they were worked by the Liverpool "Ramsbottom's." The coaches were provided by both companies, one train by each.

Leeds always kept eight or nine "Precursors" from 1875 until about 1894, when they were broken up, and their places taken by the 6 ft. 3 in. coupled "Whitworths." Although I was constantly at Leeds station, I never saw a "Precedent" there before 1884 or 1885, when the Crewe men very occasionally brought in 1193, 1194, or 2175 on their one turn to Leeds instead of the 1211 to 1220 Ramsbottoms. I never understood why the "Precursors" should have been scrapped, as they were excellent engines for stopping trains and not to be mentioned with the feeble 6 ft. coupled "Samsons" of those days. (This, of course, refers to the old 16 in. by 20 in. engines.) The "Precursors" are stated to have been rebuilt as 2-4-2 tank engines, but I understood that the tank engines were entirely new. Certainly the frames were, but they would, and probably did, use the old 5 ft. 6 in. wheels. This 910 class (2-4-2 tank engines) really originated in 1890, some three years before the "Precursors" were scrapped. My few recorded timings of the latter were all poor, the best being from Oxenholme to Carnforth with 1180 *Pearl* and 9 coaches, 12⅞ miles down the Grayrigg bank in 15 min. 20 sec., a mean speed of 50¼ miles perhour start to stop.

I have delayed mention of the oldest four-coupled engines on the line to the last for the reason that they are always associated in my mind with the Leeds and Huddersfield local trains. I refer to the celebrated Crewe goods with outside cylinders and 5 ft. wheels (see page 225). The cylinders were only 15 in. by 20 in. and their chief characteristic was an enormously long chimney. They were painted dead black without any lining out, and they never had number plates, but simply yellow figures shaded with blue on the side panels. They were to be seen in many parts of the London and North Western system, the Lancashire sheds such as Preston and Warrington rejoicing in a large number of them. Those at Huddersfield on the local services were 27, 153, 314, 330, 331 and 336. In 1880 they were replaced by 2-4-0 outside cylinder saddle tanks (504 class), which had been rebuilt by Mr. Ramsbottom from the same class of tender engine. These had 16 in. by 20 in. cylinders and were more powerful than the very similar but smaller Trevithick side tanks, of which only one was in the Yorkshire section, viz., 232, which worked the Huddersfield and Kirkburton branch. The 504 class remained on the Huddersfield locals until 1884, when they were replaced by Webb's standard 2-4-2 side tank engines, the well-known class that has done duty all over the London and North Western Railway system.

There was one important train over the Yorkshire section that I may mention, viz.,



ONE OF MR. F. W. WEBB'S 2-4-0 TANK ENGINES.
Built 1876, and used on the Manchester-Buxton, London-Watford and other services.
Coupled wheels, 4 ft. 7½ in.; cylinders, 17 in. × 20 in.

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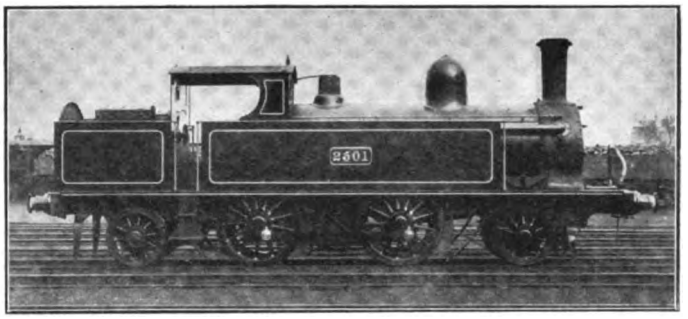
"The Bangor Mail." This train, with mail van and P.O. sorters, started from somewhere in the land of the gentle shepherd for Crewe, whence it travelled with only the Stockport stop to Huddersfield, at which place it put in an appearance at about 1.30 a.m. There was no Leeds connection, for the Lancashire and Yorkshire took charge at Huddersfield and conveyed the train to Normanton, where at that time it terminated. At Normanton it made connections with the Bristol and Newcastle through mail trains of the Midland. The Bangor Mail may have been all right from a post office point of view, but from a passenger's outlook it left much in the way of comfort to be desired, as I, who suffered in it from Crewe to Normanton on two or three occasions, can testify. There were only two or three six-wheeled coaches and the number of passengers was about twice the accommodation provided, for at that time the Bangor Mail supplied the only night train from Lancashire, Cheshire, etc.,* to the North Eastern stations. Now the Mail runs from Crewe to Huddersfield without a stop and then to York *viâ* Leeds—the London and North Western coaches going through.



ONE OF MR. F. W. WEBB'S 4 FT. 6 IN. "DOUBLE-ENDER" TANK ENGINES, AS BUILT IN 1883.

Since the first portion of my article in the January issue was published, I have received an interesting letter from an old friend, who was at Rugby School during a portion of the period with which I was dealing, and who possesses an intimate knowledge of locomotive and railway matters. He writes:

"As to the three extra large 'Bloomers,' I think *Delamere* was broken up some time before the other two *Maberley*, with the number 1871, and *Caithness*, numbered 1885, were in service up to about the middle of 1883. They had no cabs, and the regulator handle hung downwards. Of the 7 ft. 'Bloomers,' during their later years one or two were always kept in steam at Rugby station for the purpose of pushing out southbound trains. All heavy trains were pushed up as far as Clifton Junction, where the Northampton line came in, and the heaviest were pushed right out to Hillmorton. This kept one or two 'Bloomers' occupied all day.

"Until 1883 or early in 1884 the single-wheelers (Trevithick class), *Prince Eugene*, etc., worked local trains between Rugby and Leamington. They were replaced by Webb's 2-4-2 tank engines.

"Of the 'Precedents,' Nos. 2176, *Robert Benson*, and 2177, *Edward Tootal*, were transferred about 1882 from Liverpool (26) to Bushbury (13) and worked Birmingham-London expresses. This change would probably have taken place when the new 'Precedents' 253, 254, and 256, named after the American Presidents, went to Liverpool. *Henry Pease*, 364, was stabled at Crewe for some time before being transferred to Manchester. Of the 'Precedents,' the shed numbers of which were left blank (page 23), engines 193, 919, 1187, 514, and 945 were at Rugby, and 1170, 1173, 1183, and 789 at Crewe. Nos. 257 and 260 were at Rugby from 1882 until about 1886.

"I only remember once seeing a 'Bloomer' at Carlisle; and I do not think I saw a 'Lady of the Lake' there from 1884 until just at the end of Mr. Webb's *regime*, when all trains were being piloted and all sorts of engines were being used for the work."

* The "Bangor Mail" connected at Crewe with the main line mail trains of the London and North Western Railway. Passengers from Lancashire, including Manchester, for Yorkshire, had to travel from London Road station and change at Stockport.

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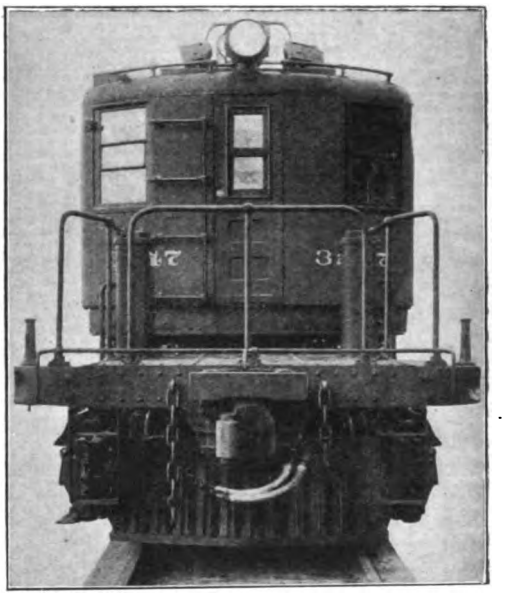
Electric Railway Progress and Practice.

THE COMING OF THE ELECTRIC LOCOMOTIVE.

By MAURICE G. SARGEANT.



FRONT VIEW OF ONE OF THE NEW 4-4-4-4 ARTICULATED DIRECT-CURRENT ELECTRIC LOCOMOTIVES: NEW YORK CENTRAL AND HUDSON RIVER RAILROAD.

WHETHER the steam locomotive will eventually be displaced by its electric rival on our main lines of railway, is one of those questions to which it is almost impossible to give an authoritative answer, so wide is the diversity of expert engineering opinion. Despite the prevalent activity in railway electrification, it would appear that until some very considerable reduction in the cost of producing electric energy in bulk, and of distributing it to trains over a lengthy system of lines, occurs the supremacy of steam traction for the majority of main line passenger and goods traffic is not likely to be assailed. In countries such as Switzerland, Norway, Sweden, Finland, and Northern Italy and Austria, the conditions are totally different; abundant water power prevails, and hence electricity can be generated at a fraction of the cost possible here. Electric traction by powerful electric locomotives will, undoubtedly, to a large extent supersede steam on the railways of these countries. Already the success attending operation of heavy goods and passenger trains by three-phase electric locomotives through the Simplon tunnel has encouraged the Swiss Government to electrify the St. Gotthard tunnel and its approaches in the near future, preparatory to introducing electric traction on the whole of the Federal Railways in course of time. The Alberg tunnel on the Austrian State Railways is also to be electrified, and in view of its heavy traffic, and the axle load limitation to 14·5 tons on this line, very large and powerful electric locomotives will be called for.

Reference has already been made in the RAILWAY MAGAZINE to the successful working of the large electric locomotives on the new Lötschberg Railway, and it may be remarked that the thirteen 2,500 horsepower 2-10-2 Oerlikon machines just put into service on this line, are the largest electric locomotives yet built on the Continent. Many important problems, both electrical and mechanical, have called for solution, therefore, in their design, and their marked success is proof of the progress of electric locomotive construction.

On practically all main lines there are districts where peculiar local conditions make the electric locomotive a much more efficient machine than the steam. Long severe grades, or lengthy tunnels involving ventilation difficulties with steam, necessarily restrict the number of trains it is possible to handle in the section. An example of the advantages of electric haulage of goods traffic on heavy grades is afforded by the results of working of the 0-10-0 three-phase electric locomotives employed on the Giovi section of the Italian State Railways. A full description of these

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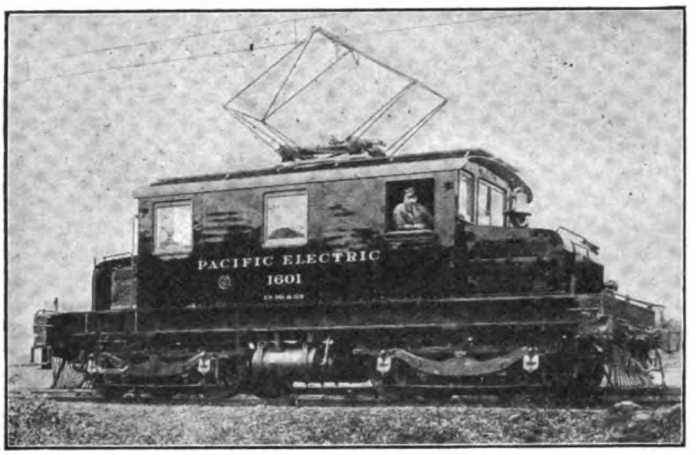

0–4–4–0 74 TON 600–1,200 VOLT DIRECT-CURRENT GOODS LOCOMOTIVE, SOUTHERN PACIFIC RAILROAD.

powerful machines appeared in the RAILWAY MAGAZINE, Volume XXIX., page 154, and it may be remarked that operating, as they do, on maximum grades of 3·4 per cent., 380 tons are handled by two electric locomotives weighing together 120 tons, as against 310 ton trains previously worked by steam locomotives of 202 tons weight. An increase in paying load of 70 tons, and decrease of 12 tons in the total load moved has resulted from the electrification.

The Hoosac tunnel on the Boston and Maine Railroad, which pierces the Berks County Hills between Hoosac and Deerfield river valleys, a total length of 25,081 ft. (the longest tunnel in the U.S.A.) was electrified solely because ventilation difficulties with steam-hauled trains were limiting the amount of traffic which could be handled on the section. One hundred and thirty ton, 1,260 horse-power single-phase locomotives, which can give a drawbar pull of 21,700 lbs. at 20 miles per hour, now handle the traffic, hauling freight trains of 1,600 tons, including their steam locomotives, through the tunnel in 20 min., and passenger trains of 400–500 tons with their steam locomotives, in 8 min. The steam locomotives are towed through, instead of being detached and re-attached, as at the Simplon tunnel, in order to reduce shunting delays outside the tunnel portals. Sixty to seventy trains can now be handled daily.

The St. Clair tunnel of the Grand Trunk Railroad is a further example of increasing the capacity of a given section by substituting electric haulage for steam. This tunnel passes under the Sarnia river and connects Sarnia, Ontario, with Port Huron, Michigan, U.S.A., and although only 3·5 miles of track are involved in the electrification, the grades through the tunnel are as much as 1 in 50. The largest steam locomotives permissible by the tunnel loading gauge, and weight restrictions, could only handle 700 tons, but two 66 ton single-phase 720 horse-power locomotives easily haul 1,000 tons. The tunnel is only single track, and electric locomotive haulage has increased the capacity of the section some 30 per cent.

Electrification of portions of main lines, with electric locomotive haulage, is, therefore, oftentimes a practicable alternative to costly widenings and track re-organisations. It must be remembered that, weight for weight, the electric locomotive can be designed to give a much greater tractive effort than a steam locomotive. Thus, the new Southern Pacific Railroad 1,000 horse-power 1,200 volt direct current goods locomotives, illustrated above, weigh only 74 tons, yet they can haul 1,200 tons on the level, 600 tons at 25 miles per hour, and 300 tons on 1 in 25, they being rated for a maximum draw-bar pull of 30,000 lbs. It would be quite impossible to design a steam locomotive and tender to exert such haulage power weighing only 74 tons. It must, however, be remembered that steam and electric locomotives are really not strictly comparable; the former is a complete power-house plant in itself; the electric locomotive can only be likened to a sub-station, in which the energy generated in a distant power-house is translated into tractive effort.

In the case of a steam locomotive, the maximum tractive effort which can be exerted with any given adhesion, is limited almost wholly by the boiler capacity, *i.e.*, heating surfaces, grate area, and steaming capacity. The electric locomotive, behind which is the relatively unlimited capacity of the power-house, combined with the possibility of temporarily overloading the motors to an enormous extent, can give immense tractive efforts for short periods, such as when ascending short sharp grades. At such times the speed of steam locomotives

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decreases considerably, owing to boiler steaming limitations, electric locomotives on the other hand, can ascend such grades at higher average speeds. It is thus possible to work heavy goods and mineral trains over heavily graded sections on much reduced schedules. Difficulties arising when goods and passenger trains of widely differing speeds have to be operated on the same lines are thus minimised.

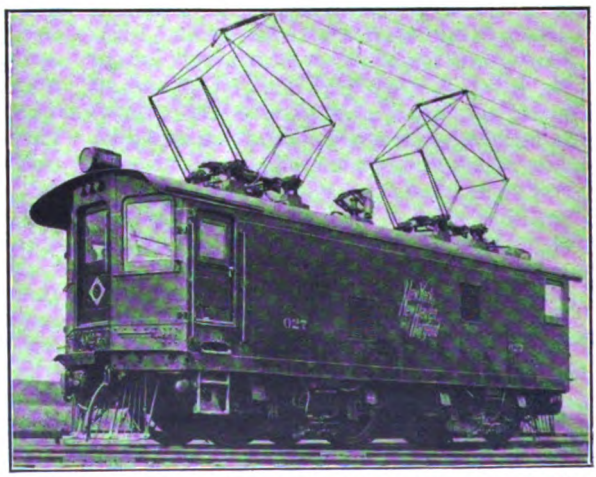
The absence of detentions due to boiler cleaning, removing of ash and cleansing of fireboxes, tubes, smokeboxes, etc., means that electric locomotives can be kept in service for more lengthy periods than steam, and, therefore, the number of engines required to handle a given traffic is reduced. The drawbar pull of an electric locomotive is much steadier than that of steam locomotives, owing to the very even torque of electric motors with their purely rotary motion, and, therefore, rated tractive efforts of 25 per cent. of the weight of the locomotive are possible, and, with sanded rails, up to 30 to 35 per cent. Perfect balance is, of course, attainable, an impossibility with steam locomotives, and with the latest designs of electric locomotives in service, in which the method of construction adopted has given a high centre of gravity, it is found track maintenance costs are much lower than where steam locomotives of equivalent power are employed. This has been the experience of both leading American lines, and of the Italian State railways.

Driving wheels much smaller than in steam practice are possible, owing to the absence of reciprocating parts. Electric locomotives not only "get away" quickly, but at the same time attain the highest speeds with perfect freedom from any degree of destructive vibration.

At the present time the design of electric locomotives presents much greater diversity than that of steam locomotives. The principal points of variation may be summed up as: (1) Methods of power transmission from motors to driving wheels; (2) wheel arrangements; (3) class of current used, three-phase or single-phase alternating, or direct current; (4) type and number of motors, and speed control system.

The earliest electric locomotives had their motor armatures directly built up on the driving axles, thus entirely eliminating gearing. The arrangement has the disadvantage that a large portion of the motor weight is un-spring borne, and this, in conjunction with the low centre of gravity, makes the engine rough on the track, more especially at curves. Nevertheless, the New York Central Railroad has adopted this construction for locomotives giving upwards of 3,000 horse-power, and although they have large side-rod locomotives for passenger service, in their latest 4–4–4–4 articulated electric locomotives, with eight motors, they have returned to the direct-mounted gearless drive. These new locomotives, it may be remarked, are claimed to haul 1,000 ton trains at 60 miles per hour, and to develop 5,000 horse-power for short periods.

The most widely adopted type of construction, however, is that in which the motors are nose suspended, driving through single reduction spur gearing, an arrangement adopted in 1,000 to 1,200 horse-power engines. The 800 and 1,200 horse-power locomotives of the Metropolitan Railway, and the 1,000 horse-power locomotives of the Southern Pacific and Paris-Orleans Railways, are familiar examples, and the new 1,500 volt locomotives now building for the North Eastern Railway will be on similar lines. While, however, permitting the greater portion of the motor weight being spring supported, this drive does not eliminate the objectionably low centre of gravity, and the system of power transmission put in on the single-phase 2–4–4–2 express and goods locomotives, and 0–4–4–0 shunting engines,



EARLIER TYPE OF COMBINED SINGLE-PHASE AND DIRECT-CURRENT ELECTRIC LOCOMOTIVE: NEW YORK, NEW HAVEN AND HARTFORD RAILROAD.

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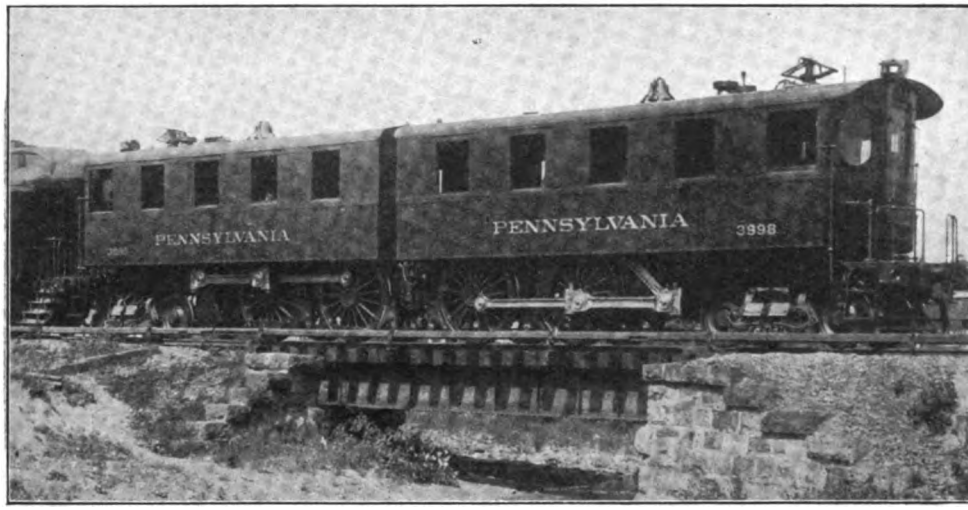
of the New York, New Haven and Hartford Railroad may be cited as retaining the good features of the gear drive, while the motors are placed in such a position that a high centre of gravity is secured. Around each driving axle is a hollow steel shaft, known as a quill, which is carried in bearings on the underside of the motor frame. The motor is placed directly above the driving axle, and drives a spur gear carried on this quill. From the ends of the quill the drive is transmitted through six coiled springs to each driving wheel centre. The driving axle is thus free to move vertically, or at right angles to the quill centre, and perfect flexibility is secured. This drive has been most successful, and is employed in the large new express locomotives put to work on this railway, of the sufficient adhesion weight is obtainable, the number of driving axles is reduced with consequent shortening of the wheelbase. In addition, the motors being mounted high up on the locomotive main frames are more accessible for lubricating of the bearings, adjustment of the brushes, truing of the commutators, etc.

The large new 4,000 horse-power 650 volt direct current Pennsylvania Railroad electric locomotives are a good example of this type. As will be seen from the view of No. 3998 (given below), they are the equivalent of two 4-4-0 locomotives coupled back to back, this construction being adopted to give the maximum flexibility of wheelbase. The drive is transmitted from cranks on the motor armature, through coupling rods to



4-4-4-0 PENNSYLVANIA DUPLEX 4,000 HORSE-POWER ELECTRIC LOCOMOTIVE.

2-4-4-2 type, which have eight 170 horse-power series motors, constructed to run with either 300 volt single-phase current, when on the New Haven lines, or 650 volt direct current, on the New York Central lines. These engines weigh 120 tons in working order. The same drive is used in some similar locomotives of this line which weigh 140 tons, and are capable of exerting a tractive effort of 40,000 lbs., and give a drawbar pull of 12,700 lbs. at 35·5 miles per hour.

For electric locomotives, however, developing very considerable powers, large slow-speed motors coupled to the driving wheels are largely used. The efficiency of big slow-running motors is much higher than that of smaller machines, and if a dummy shaft in the main frame parallel to the driving wheels, to which it is connected by side-rods. The reason for the oblique drive from motor to dummy shaft is to reduce the upward thrust on the latter's bearings, thus securing smooth riding. It will be readily apparent that by the use of the dummy shaft the driving axles are perfectly free to rise and fall with inequalities of the track, without affecting the motor connecting rod centres in any way. Unlike a steam locomotive, the weights of the various rods can be perfectly balanced, as their paths are entirely circular. These locomotives are among the most powerful in the world, and have driving wheels 6 ft. diameter, with a total adhesion for the four axles of just on 100 tons. The rigid wheelbase of

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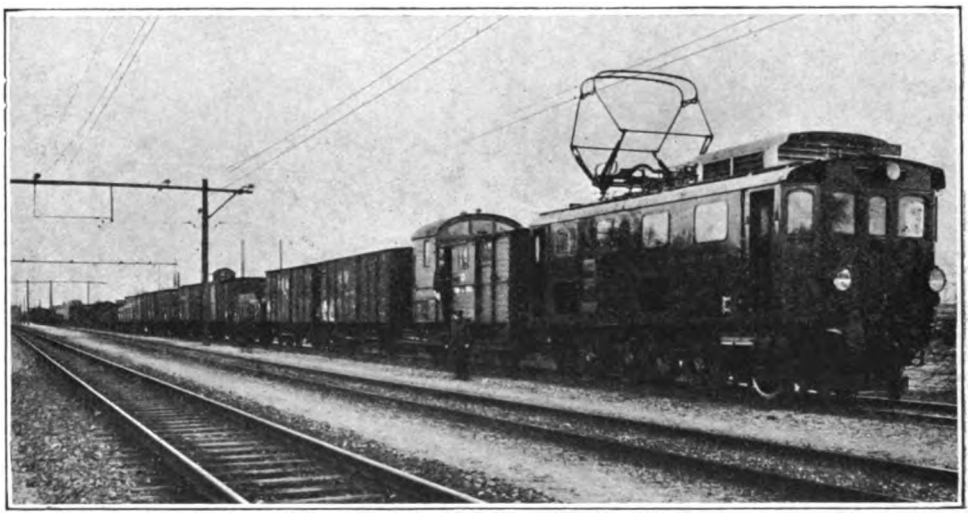
the drivers is 7 ft. 2 in., the total wheel base of each unit being 23 ft. 1 in., and of the whole machine 55 ft. 11 in. The maximum tractive effort is 60,000 lbs., though on test the locomotives developed a drawbar pull of 79,200 lbs. They can haul 550 ton expresses, and operate on the New York City, and Brooklyn and New Jersey divisions of the Pennsylvanian Railroad, as owing to the heavy traffic and lengthy tunneling under the East and Hudson rivers, steam locomotives have now been entirely withdrawn from that Company's New York terminal and its approaches.

Side-rod gearless electric locomotives are extensively favoured on Continental electric railways, and the illustration on this page shows one of the new 2–6–0 800 horse-power



2–6–0 800 H.P. SINGLE-PHASE LOCOMOTIVE FOR THE MITTENWALD RAILWAY.

single-phase locomotives recently put into service on the Bavarian Railway Administration's Mittenwald Railway undergoing its trial run. In these locomotives there is only one large 800 horse-power motor driving a dummy shaft which is connected to the driving wheels by coupling rods. They are designed to haul 124-ton trains on 3·64 per cent. grades, but two coupled together and operated as multiple units can handle 240 tons. Incidentally this illustrates one of the advantages of electric locomotives for sections where double-heading is occasionally required for train loadings above the average, since two or more locomotives can be coupled together, and by the use of multiple unit switches, only one driver is required on the front engine. This practice is adopted in the St. Clair tunnel on the Grand Trunk Railroad, on the Giovi lines of the Italian State railways, on the Spokane and Inland Empire Railroad, and several other electrified lines for handling the heaviest trains. The Mittenwald locomotives have hauled 1,100-ton trains on the level with ease. There are five of them in service, and each cost £5,925.

Combined geared and side-rod transmissions are now favoured on the Continent, more especially in single-phase locomotives, in which the motors are geared to the dummy shaft, or shafts, which are in turn connected to the driving wheels by coupling rods. This obviates vibration troubles inseparable from alternating current motors, which have caused trouble with coupling rod bearings in locomotives with side-rods only. The new 2–10–2 2,500 horse-power locomotives of the Lötschberg Railway are an example of this method of construction, the motors driving the dummy shafts by triple helical gear, and the five pairs of drivers being coupled to the dummy shafts by side-rods.

In regard to wheel arrangements, the double bogie type is still the most popular, and the majority of electric locomotives are of this type. In the latest New York Central articulated electric locomotives there are two main frames coupled together, each carried on two four-wheeled bogie trucks, the locomotive having thus eight driving

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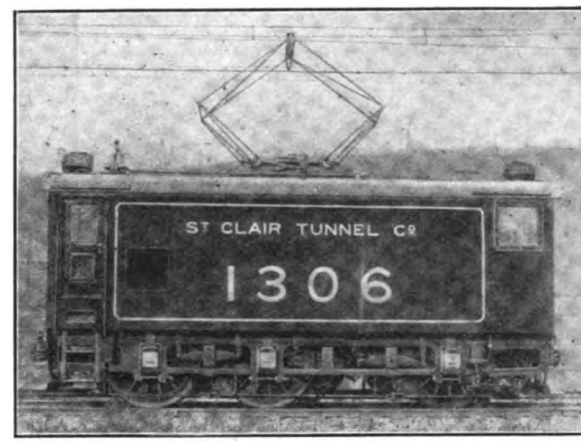
axles distributed over a wheelbase of 45 ft. 7 in., though the maximum rigid wheelbase—that of the outermost trucks—is only 6 ft. 6 in. Earlier electric locomotives on this line are of the 2–8–2 type, with rigid driving axles, and pony trucks. 2–6–2 locomotives are in use on the Baden State Railways, Wiesenthal line, having two single-phase motors arranged at the outer ends of the frames, and driving rigid driving axles through dummy shafts and coupling rods. On the Dessau-Bitterfeld section of the Prussian State Railways there is a somewhat unusual design, namely a 4–4–2, which, unlike most electric locomotives, is intended to be turned at the completion of a run, so that the four-wheeled bogie may lead. This is a side-rod locomotive, there being one large 1,600 horse-power series single-phase motor, driving through a dummy shaft, located between each pair of drivers, and coupled thereto. With 240 tons a speed of 68 miles per hour is attainable, the driving wheels being 5 ft. 3 in. diameter, and a tractive effort of 15,400 lbs. at starting can be exerted. 0–8–0 goods locomotives of similar design with one large motor, and 2–8–2 goods locomotives having two motors, the cab sides in these latter being open to ventilate the machines, are employed on this section of the Prussian State Railways. The first-named can haul 700 tons at 20 miles per hour, and 1,400 tons including the weight of the locomotive, for one hour at 15½ miles per hour; the latter haul 1,200 tons at 21·3 miles per hour, or 700 tons at 35 miles per hour, the maximum tractive effort being 39,700 lbs.



720 H.P. 0–6–0 SINGLE-PHASE ELECTRIC LOCOMOTIVE USED FOR WORKING THROUGH THE ST. CLAIR TUNNEL, GRAND TRUNK RAILROAD.

For the Kiruna-Riksgransen line of the Swedish State Railways some electric locomotives have just been built comprising two 0–6–0 units coupled, each unit having one large motor with side rod drive to the wheels. They are to haul ore trains of 2,050 tons at 31 miles per hour on the level. Of locomotives built for the various direct and alternating current systems, the electrical equipment of the former is far the simpler, both as regards wiring control, and weight. The speed of direct current locomotives is invariably controlled on the series-parallel system, the motors being all connected in series till about half-speed is attained, when they are re-connected in parallel to the incoming current. The motors are invariably series wound. The weight of the motors and equipment in three-phase alternating current locomotives is usually greater, owing to the provision of large rheostats, which regulate the current flowing in the motor rotors, and thus control the speed, while the motors themselves are usually larger, running at only moderate speeds. In the Simplon tunnel locomotives the speed is adjusted wholly by changing the number of motor magnet poles in circuit. Three-phase locomotives present one unique feature in that when running down hill as soon as the speed of the train exceeds a certain limit the motors automatically return current to the line, easing the load on the generating station, and forming a powerful and effective brake to the engine. This "regenerative control," as it is termed, is now being developed in single-phase traction, but is not yet very successful. Single-phase locomotives are usually much more complicated than direct current, or three-phase, as owing to the high pressures used on the overhead lines—15,000 volts or so—a transformer has to be carried to reduce the pressure to a considerable extent before the current passes to the motors. Speed control is largely secured by switching in the transformer secondary winding in sections, thus applying variable voltages to the motors. Forced ventilation is now largely applied to the motors of both direct current and single-phase locomotives, electrically-driven blowers being carried in the cabs to supply the necessary cooling air. By this means a bigger output is secured from a given motor equipment. Amongst other appliances carried are motor-driven

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air compressors, or exhausters, according to whether Westinghouse or vacuum brakes are used, and small motor generators to supply current for the head and cab lights, and to operate the necessary switches, etc.

Driving electric locomotives is obviously a much simpler business than with steam, there being no injectors, steam gauges, or water level indicators requiring constant observation. Intelligent operation of the controllers and brake gear, and keeping a good look out ahead, form virtually the only duties of the motorman. As regards repairs, electric locomotives are extremely light. The Simplon tunnel engines have run 87,000 miles before heavy overhaul was needed, the 33 electric locomotives on the Pennsylvanian Railroad's New York division only caused 13 min. delay in a twelve-month by breakdowns, the six St. Clair tunnel Grand Trunk locomotives each ran 70,000 miles in two years without a single breakdown, and altogether it may be said that electric locomotive upkeep costs are below those of steam locomotives. Even for shunting operations with their constant stopping, re-starting, and generally trying conditions of service, electric locomotives have proved satisfactory, though the impracticability of electrifying large extensive goods depots and sidings points to the field which there is undoubtedly for storage battery locomotives in this direction.

In conclusion, the writer would like to combat the frequently expressed idea that electric traction reduces the interest of railway operation. The steam locomotive is unquestionably more spectacular than its electric brother; but for those who care to investigate, the latter will be found to present much of the greatest interest, while, for the speed enthusiast, it may be noted that electric locomotives are now performing daily—more particularly in the U.S.A.—runs which combine the highest speeds with train loads ranging up to 500 tons or more, and electricity certainly promises developments in this direction far beyond what is possible with steam traction.

LONDON & SOUTH WESTERN RAILWAY
ROLL OF HONOUR
Number of Company's men serving with
HIS MAJESTY'S FORCES
313 239 531 154 669 493 97 2,406
16·2 13·4 10·2 6·5 13·2 5·6 12·4 9·9
THE UNDERMENTIONED HAVE
DIED ON ACTIVE SERVICE
(KILLED IN ACTION, DEATHS FROM WOUNDS, OR OTHER CAUSES)

THE LONDON & SOUTH WESTERN RAILWAY COMPANY'S ROLL OF HONOUR.

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Leaves from the Log of a Locomotive Engineer [No. XXX.].

By ROBERT WEATHERBURN.

[*These articles commenced in October, 1912, and have been published continuously ever since. As a record of an eventful life as a locomotive engineer they are unique, for Mr. Weatherburn's career has included experiences such as have fallen to the lot of but few men. Mr. Weatherburn also knows how to dovetail practical comment and interesting narrative, and though with the present article this series of reminiscences is concluded, we hope to publish further contributions. Though he has now passed the "allotted span" in years, Mr. Weatherburn is spending his well-earned retirement in enthusiastic work on behalf of his country, and in other ways is still active as a writer and as a leading spirit in many associations in which he is interested. In this concluding instalment the author deals with an event which might be considered inconceivable, were it not that it is so strongly attested. He concludes by setting forth some character studies, all from real life, which will appeal to many descendants and relatives of the men referred to.—Ed.*]

A NOTABLE illustration of what some men will risk with impunity and prove the old saying "that nothing succeeds like success" came under my notice in Königsberg in 1870. I had journeyed from Eydtkuhmen thither in order to meet the Maschinen-Meister of the East Prussian Railway, to arrange for the loan of five or six fitters to be quartered by me on the frontier. After concluding the business satisfactorily, I announced my intention of returning to Eydtkuhmen by the earliest train, which I was assured would be late as the weather was hard and the snow deep. The Herr Maschinen-Meister said he was anxious as to the arrival of the Russian mail train, which was then overdue, and he would accompany us to the station. I may here say that I had an assistant along with me, and we promenaded the somewhat crowded platform together.

The officials were now and then craning their heads and peering into the perspective to catch the first glimpse of the overdue train. At last it came into view, and as it slowly drew nearer it was evident to all that there was something wrong; the engine rode very unsteadily and at last entered into the station with a jangle and wobbling like a cart on a rough road. The Prussian engineer and ourselves walked some dozen yards to meet it. The first thing that caught my eyes was the absence of the right-hand splasher and nearly one-third of the naked rim of the driving wheel minus tyre advertising itself above the footplating. The engine was a four-wheeled coupled one of approximately 66 in. diameter.

I ventured to assert to my companion that so strange an occurrence as seeing a train brought in under such conditions might not again happen in a life time. As is generally known full sized platforms do not as a rule exist on foreign railways even now. Certainly at that time the levels were nearly the same at Königsberg, so that I walked to the trailing wheels and saw at once how it was just possible to bring an engine and train in under such conditions. In the year 1870 the tyres were not generally safety-lipped as at present in Germany. The almost general practice on English railways is *not* to turn down tyres below 1¾ in. thick at the tread or measuring with the safety lip 2¾ in. The lipped tyres and system of contraction and screwing have practically put an end to such accidents as throwing or breaking tyres. The engine in question had the thinnest worn tyres that I had ever seen, ¾ in. thick, and fastened with screws through the centre. I had many times remarked the danger of running their tyres so thin, but had always been assured that they had no reason to complain, as breakages were rare, and the quality of the steel (Krupp or Bochum) exceptionally good; and the further argument that they got at least 60 per cent. more wear out of them.

The driver seemed the least concerned of any, and his chief seemed rather gratified

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than otherwise at the train having been brought in. The reader will already have asked himself the question, What about the rods? Certainly the outside rods were there with cotters slacked back and all a jingle. The spring had sufficient camber as to take up the thickness of the missing tyre.

How the tyre freed itself from the wheel without damaging the coupling rods or derailing the engine can only be conjectured. No doubt the tyre broke when slipping and the conditions resulting would not be far short of a flight of shrapnel. The peripheral difference between the two wheels (on the same axle) would be nearly 4¾ in., yet the time of their rotation the same with a slight variation of peripheral speed. How was the difference absorbed?

I have ever since regretted my inability to obtain further information regarding this case, particularly as to how far the engine had to travel before reaching Königsberg. It is only reasonable to conclude that it was not far away where the accident happened, otherwise the train would not have been brought in. There is a certain pardonable reticence on the part of all railway officials to give information or data concerning such things to the outer world; but the high-hedged officialism of the Prussian State railways is actually prohibitive, and treats any such enquiries as rank impertinence and with manifest displeasure. The engine only remained under our observation a short time, as under ordinary circumstances it had to come off at Königsberg to make way for another, which linked up with Berlin.

It reminded me of the strange practice of a locomotive superintendent with whom I had a conversation forty years ago. He was explaining how he had dealt with some six-wheeled coupled engines which, owing to faulty design, had a difference of fifty hundredweight on the axles, with proportionate difference in wear. So when retyring he made the difference in diameter the other way, turning the diameters in proportion to weight and wear, some as much as ¼ in. larger or smaller as the case might be. And the result, I enquired? "Oh, it was not quite satisfactory," he answered, "and then I tried to get steel of different hardness to suit the different weights." "And what happened?" I asked. "Why, it did not turn out the success I expected."

No Englishmen visiting St. Petersburg in the 'sixties or earlier 'seventies but what knew Boyers Hotel in the Galerni. Years before I was privileged to know it, it was the rallying place of a symposium of the choicest spirits that ever gathered under one roof in a foreign land. Railwaymen, and particularly engineers connected with such in the surveying, construction, and management stages in whatever part of the Empire, invariably stayed at Boyers' when in St. Petersburg. If you landed from the steamers at the English Quay at the Wassili Ostroff, or the Nicolai station by rail, the shaggy headed but keen-eyed Isvostchik (coachman) intuitively recognising the Englishman, would without further enquiry, unless otherwise directed, drive them to Boyers'.

Boyer himself was for many years the well-known and popular "Magor Domo" to the British Embassy, and on leaving there took up the duties of hotel proprietor, for which few men were more fitted both in appearance and affability. His experience in both countries enabled him to understand and cater for new arrivals, particularly those who had not as yet graduated into the eating and drinking customs of the country, and had yet to acquire a taste for raw salt herring, or caviare with a small glass of wodka as a preliminary to a breakfast of coffee and rolls. The two menus met the difficulty of the new arrival or the old stager according to taste or fancy. Beef in the round, ribs, or steak, were prepared English fashion for those who preferred it. The menu "a la Russe," with the preliminaries Zakouski, was always on the sideboard of the refectory, with its many novelties; and as a rule the inductory process was by no means a long or severe one to new comers, who soon got to like the caviare, smoked raw salmon, and goose washed down with a thimbleful of Achesni wodka. Besides which the curse of the Tower was not in evidence within the hospitable walls, as Ivan the chief waiter and factotum—no bad imitation of the immortal Sam—was a veritable authority and book of reference as to the whereabouts of all notable Englishmen from the Neva to the Caucasus, as well as a reliable authority and adviser in all matters regarding the city. I remember the pleasant gatherings in the long room and the preliminary introductions to men high-dried and seasoned by hardships and isolation in the interior, who occasionally found relief and relaxation in a short respite from the hard fare and rough living inseparable from the task of laying out and developing the iron roads of the greatest contiguous empire of modern times, among and with the aid of, peasantry in many

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respects just emerging from the ignorance and superstition engendered by centuries of serfdom.

I can see and re-people the room as I last saw it: first noting the stove with its bright porcelain front, with no sign of fireplace or fire, yet in winter maintaining a genial and uniform heat throughout the whole room, leaving no coign of vantage in the way of nook or corner to be sought or needed. And the walls here and there studded with specimen heads of the fauna and amphibae to be found in the wide stretch of territory ranging from the gulf of Bothnia to the river Yenesei. A magnificent trophied head of the great elk, still a denizen of the forests, flanked on one side by the huge head of a "Wapiti" which was reported to have been shot on the Alaskan American frontier, and on the other side (strange anomaly) by the heads of two seals almost human looking, with their large eyes and steel grey fur.

In the corner nearest to, and sentinelling the door, with open mouth showing his great teeth and red throat and palate, a monstrous and splendid specimen of the great black bear, standing upright with his fore legs like arms outstretched, and black unsheathed claws, emblematic and in keeping with the national characteristics of the country. The long table, thoughtfully provided with the elements most likely to favour a company as diversified in habits and character as it was unanimous in its desire to sink all distinctions of rank and education, at least for the time being. For the scientifically trained experts and the rough, practical, hard-headed men who had forced their way to recognition were a little democracy held together by the ties of common interest and nationality. Occasionally there would be a sprinkling of the foreign element, who, by long association with Englishmen, had become habitues.

There is George Garwood,* deaf as a post, and gouty to chalkiness, who made his devoir and mark under "Ross Winans," the great American concessionaire and contractor of the St. Petersburg and Moscow Railway, and afterwards the inventor of the Winans' cigar ship. George reclines negligently in an arm chair of undoubted English make, and blows the smoke of his papyros lazily towards the ceiling. He has had, and will have before he finishes his career, more varied experience in the empire and elsewhere, than any man in the room. At his side, and occasionally trumpeting in his ear, is C——, just appointed to the position of Chief of Traction of one of the largest lines, having Moscow as its centre. He is anxious to obtain the latest doings on English railways, and pesters George and the company by talking shop. Nevertheless, like George, he speaks Russian.

The tall, sinuous, blonde-looking man talking to Ivan in fluent Russian is Wardle, of Orel, who belongs to an old north-country stock long resident in Russia, whose experience would fill a volume. He accompanied an expedition into Khiva and Bokhara long before the brilliant Skobeloff, their conqueror (of Plevna fame) had gained his cadetship. On his return he was engineer of the Government steamers on the Volga. Now he is Chief of Traction at Orel.

A short, clean-shaven man smoking a cutty pipe in hand, one of Sharp Stewart's staff, who is known among his friends as the "Incendiary," or the man who set the village of Miranda, in Spain, on fire when climbing a bank with a low fire. He deprecates any allusion to it, unless he be in a mellowed condition.

The tall, reserved man with the chin tuft, and deeply lined intelligent face seated near the stove, listening intently, and smoking a huge Kuchinsky cigar, is Blatt, an American, and an old acquaintance of Garwood's. He is justly reputed to be wise and sagacious. He is the Czar's special locomotive engineer inspector, and accompanies the Emperor (Alexander) on all his railway journeys. He has come specially from Moscow, where he resides, for that purpose now. He is accredited with the habit of taking his tobacco in two forms at the same time—smoking and plugging—but is never known to expectorate, and the most lynx-eyed observer has never seen what he does with the "cud" before taking his occasional sip of Guinness' stout, which he declares is the only real nectar worthy of the gods, and of which there are several bottles on the table that by some occult process have never paid their dues to the Tamogni (customs).

The dark-complexioned and athletic-looking man who sits next to the "Incendiary," and who has been discussing the merits of engines known to both, is Keen, a Derby man, Assistant Locomotive Engineer

* Incidentally, the writer has lately heard that the "Memoirs of Mr. G. Garwood" were published some few years ago, and would esteem it a favour if any of the numerous readers of the RAILWAY MAGAZINE can give him any information as to the truth, and if so, where such book can be obtained.—R. W.

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on the Kursk and Orel; not a school-bred man, and distinguishable by his county's vernacular in a way which "canner" be mistaken, but a real good fellow, and blessed with a wife whose kindness of heart and hospitality were known by all Englishmen who had the good fortune to make their acquaintance. He has just told the company that he expects his brother-in-law, Smith, to come in at any moment, and seemingly in verification, the door is opened by the attentive Ivan, and, amid a puffing and blowing consequent on a sharp flight of stairs not agreeing with adiposity, there enters a round, jovial-faced man, broad in the beam, whose smiling face is the picture of good nature.

Evidently George Smith is a general favourite, judging by the terse, queer greeting of Blatt, who is of the non-emotional order of beings, but who seems genuinely pleased to see him. George is liked for a good many reasons, chiefly being always to the fore in helping new comers, or giving advice. Then his very presence inspired good humour, and his hearty, boisterous laugh, in which face and body joined, became infectious. He glories in his Derbyshire origin, and is remarkably nimble, despite his obesity. After shaking hands all round he sits down by his brother-in-law, Keen, and while they are engaged I will introduce him to the reader.

George was, I believe, a joiner and wagon builder by trade, but his powers of adaptation were only exceeded by one man known to the company (Fitz). He soon showed of what material he was made in Russia, and literally jumped into popularity. Took small contracts for wagons and other vehicles. Started a well-appointed factory for all sorts of woodwork in St. Petersburg, including some thousands of boxes for ammunition for the Government—but I am anticipating. He was a sub-contractor at the making of the Riga and Dünaburg Railway both for wagons, tips and small stations; but above all, he was a typical Englishman in all those qualities of heart and hand which endear. In education, limited to the three R's, yet ingenious to invention, and dearly loving a joke.

A few days before the official opening of the Riga and Dünaburg Railway by the Governor-General, assisted by the notabilities and *élite* of the provinces of Livland and Courland, it was realised that no arrangement had been made for a guard, and as the line was a purely English one, the management asked George to fill the post for the day. Nothing suited him better. He got a message through to Hull, and by next steamer the largest uniform procurable was sent, including whistle and cap. The weather and George were in collusion, and after a most successful and enjoyable trip, in which George was ubiquitous in his attentions, and most amusingly and thoroughly maintained the highest traditions of that service with the greatest punctilio, the Governor-General, who had been a former Ambassador in England, in collaboration with the other gentry, to George's great surprise put in his hand a roll of roubles amounting to 1,300—at that time equal to £156.

Never had guard so rich a gift. To his credit be it said that he scrupulously divided it with the men on the footplate. If a man's good work lives after him, he will not easily be forgotten. Nor can I forget the practical and much-needed help and advice that he gave me under trying and dangerous circumstances on the swollen waters of the canal leading to the Novo Kalinken, as related in a former chapter, No. 14, November, 1913.

A peal of laughter from Keen, who had been listening to the quick gasping staccato voice of his brother-in-law, startles the company, and the "Incendiary" suggests that "if there be anything good let the company have the benefit." This being duly acclaimed, George, no ways loth, relates the following incident which had recently occurred.

"The *Milo* (s.s. Wilson Line *ex*-Hull) had arrived in Cronstadt, and I went to the English Quay to see Captain S——. Before they could get her moored I was on board, and after shaking hands we went down into the saloon to drink his health and talk about a new tenoning and morticing machine he had on board for me, when he suddenly drinks off, and, calling on me to follow, said I had quite forgotten, George, but I have brought a couple of Derby men as passengers to Petersburg for the new India-rubber works, and I had clean forgotten them—for the moment. When we got on deck the Cronstadt and other passengers had cleared off. We went ashore into the Customs shed, and were told that they had cleared, and passed their luggage (two carpet bags and a box). The captain was annoyed, but I knew the ropes, and hurried to the Droshky stand, and there, sure enough, were two chaps looking as helpless as children, holding a box with iron handles between them, and each

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having a carpet bag in the off hand, talking to the only droshky man left."

"So I walks up behind to hear and take stock, and one of them, the smartest of the two, who had evidently been told to make his bargain beforehand, after looking at a paper he pulled from his pocket said, 'How much to the English India-rubber factory for me and my mate and luggage ?' "

"The driver eyed them over without at once answering, when he axes him again, not in the same way, but 'How much for us tew to the Goloshes India-rubber factory ?' 'Ne Punimi, Punimi Boyers' " (which means, don't understand, understand Boyers).

"'What's he say ?' Tom asked the other. 'Well, as far as I can make out, he'll take us for a penny a mile as boys.' "

"'By gum, but that's cheaper than Derby,'" and George laughed from his stomach upwards at the recollection. After wiping his eyes, he continued, "I bargained and gave them the right amount, as they knew nowt about the money and arranged to call upon them the next day and put them straight. They had come from Darby to teach the natives how to make elastic web, and two factory gurls are to follow by next boat. I canner tell how they'll manage, as they dunner know a word of Russian.' "

"Well, how do you get on with the Russians, I mean the town authorities ? I see you are putting the girders in position, you can report progress now." The speaker, who smiled very encouragingly, is Mr. B——, the sub-manager of the Iron and Steel Forge in the Chagonni. The man to whom the question is put is the representative of Messrs. Handyside & Co., of Derby, who had now for some weeks been supervising the erection of new bridges over the Zagarodnoi Canal. The answer was, as I expected, from a new comer. "He liked the country, but what with Preisniks (holidays), wodka, the red tape of the police and town authorities, why, d—— it, a man required not only the patience but the goodness of Job to keep his hair on."

I liked the last speaker, who was comparatively a new comer, but he had the bearing and manner of one who knew his business, and would not stand at a trifle. Nearly if not fully 6 ft. high, smart and self-assured, educated and altogether a good specimen of an Englishman. "As for progressing, I'm ashamed of it. Why, in England I could have put up two bridges in the time, but I'm getting a better hold of the language, which I find of great advantage, as it is very telling in swear words that help me a lot."

The old stagers looked at each other knowingly, and one remarked that he "wished old Fitz was here." The Derby man crimsoned.

"I have heard this Fitz spoken of a few times already, may I ask what bridges has he put up, and where ?"

Blatt, the American, seemed to become interested, and drawled out that "Fitz was just a square man, who never complained of men, customs, or authorities, but took them as they come. He guessed that he log-rolled them the right way," and proceeded to fix up another big cigar.

The Handysider was evidently nettled, and affirmed that he "feared neither Fitz nor any other man at bridge work, be it screw pile, girder, or suspension. There was a little electricity in the atmosphere, and Garwood, despite his infirmity, felt it, and questioned C——, who explained the situation to him.

"Oh ! it's Fitz, is it ; why, Smith can say something on that head," said Garwood, who at once became interested in the situation, as he knew Smith was very proud of being "Derbyshire bred," and at once saw the racy diplomacy of calling on him to become the champion of his whilom friend and former leader, the absent Fitz, against his own county man.

George evidently felt the awkward position, but loyally fulfilled his obligations to his old leader Fitz, with as little injury to the *amour propre* of the "Derby bridger" as possible.

"Well," he commenced, "you see Mr. Fitz is not a bridge builder, although he has put up several, and far away from any town or foundry, or professional help ; but I know this, that he built a wooden bridge of sleepers in forty-eight hours actual work on the Baltishport extension, to take the place of the real bridge lost at sea between Middlesbro' and Riga, and thus kept his pledged word to have all ready on a certain day."

"Oh ! a sort of trestle affair, was it. Perhaps you can give me some idea of the height, length, and whether single or double road, and the weight carried by this wonderful bridge ?" queried the Handysider.

"Well, I can't give you the exact measurements, but it was over 30 ft. at its highest, and from buttress to buttress 70 ft., and it might be called a trestle by some people, but I should call it part and part."

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"Now, Mr. Smith, that's neither one thing nor the other; can't you explain how, and in what form, he used the sleepers?" asked the younger man.

George looked around the room, evidently seeking some method or means to illustrate with. His townsman, anticipating his wants, pulled out a large envelope and offered it and a pencil.

"Oh, I'm not much of a hand at making a drawing, although I can work to any sort, but look here"—— and then his perplexity vanished. "You can see a sketch or drawing of it at the Government Polytechnical School here, and I believe there is one at Moscow; but it was built, as I said, of sleepers, diagonalled, trussed, and braced together principally with dog-bars, and stiffened longitudinally by means of light flat-bottomed tipping rails spiked on, and it stood the test of nearly four months work until the proper duplicate bridge was put up."

"I can't believe it," said the expert, but the company, when appealed to, not only bore out George's statement, but supplemented it with other remarkable feats by the same man, who, though hardly able to sign his own name, had conceived and worked out original schemes and plans (to meet unexpected dilemmas) which had built up the vicarious reputation of some, and extricated others from difficulties that would not have justified the honorific titles or initials appended to their names.

I had the unexpected opportunity when in Reval of gratifying my desire of seeing this remarkable man. Having some little business with the English Consul, he incidentally mentioned Fitz's name as being a well-known railway engineer. He supplied me with his address, and I spent a most interesting and profitable evening with him.

But of this meeting, and of Mr. Fitz and his work, I have already told in the fifth article published in February, 1913.

In conclusion the writer desires to again express his sincere thanks for the kind manner in which these chapters have been received and commented on by many of the readers of the RAILWAY MAGAZINE in nearly every part of the Empire and elsewhere. Doubtless some have been influenced by friendship for the writer rather than the qualities of his pen. In that event it is the more gratifying. Yet the chief pleasure experienced is the reflection that he has succeeded through the medium of the RAILWAY MAGAZINE in showing his profound appreciation for, and paying tribute to, the memory of men whom he had the good fortune and privilege of meeting in the past, who quietly, if not unobtrusively, did so much both in the engineering and commercial sense to make railways what they now are. Posthumous honours are generally regarded as of little value, if not deprecated, yet if any instance or incident recorded by me may have been the means of gratifying or causing pleasure to some of the descendants' kith or kin, I shall be amply rewarded.

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Staff Changes on the Underground Electric Railways.

AS from Monday, January 25th, important staff changes have been made affecting the Metropolitan District, London Electric, City and South London and Central London Railways. Mr. W. E. Mandelick, in addition to his office as Secretary to the Underground companies, is appointed Business Manager; Mr. Z. E. Knapp is appointed Manager for Maintenance and Construction; Mr. H. E. Blain becomes Operating Manager; Mr. W. E. Blake, in addition to his position as Superintendent of the Line to the District Railway, is appointed Superintendent of the Line to the London Electric, City and South London, and Central London Railways, in place of Mr. J. P. Thomas, who has resigned his position with these companies, to become General Superintendent of the London General Omnibus Company, Ltd.

Mr. W. E. Mandelick is one of the best known officers controlling the working of the T.O.T. combination. Born in New York in 1873, on leaving school he made a special study of electrical developments, and entered the service of one of the leading American companies dealing with electrical industries. He came to Great Britain with the late Chas. T. Yerkes in 1901, and was appointed Secretary of the Underground Electric Railway Co. of London, Ltd., when that Company was incorporated in April, 1902. Mr. Mandelick is now Secretary of not only the Underground Company, but of the allied "tube" lines, the District Railway, the London General Omnibus system, the London United Tramways, and other agencies now associated with the Underground Electric Railways Co., Ltd.

Mr. Z. E. Knapp, who becomes Manager for Maintenance and Construction, has occupied the position of Chief Engineer to the Underground Electric Railways Co., Ltd., for nearly two years. His first appointment in connection with these lines was that of Assistant Engineer, in 1901, and he has been closely identified with the electrification and modernisation of the District system, and with the construction and equipment of the London Electric "tubes." He has had much to do with the erection of the power house at Lots Road, and the new rolling stock, though these, and also the engineering work proper of the respective lines, are actually under the control of Mr. Cooper, Mr. Agnew and other departmental chief officers. In 1910 Mr. Knapp became General Manager of the London United Tramways, returning in 1913 to be Chief Engineer of the Underground Electric Railways Co., Ltd., which position is now amplified as stated above.

Mr. W. E. Blake, now Superintendent of the Line for all the railways concerned, entered the service of the Metropolitan District Railway in 1887 as a junior clerk in the Outside Traffic Department. After subsequent experience in charge of one of the stations, he was transferred to the general offices, first as staff clerk and then as time-table clerk. In connection with the changes prior to the electrification of the railway, he was appointed Superintendent of the Line, so that most of the important traffic developments associated with electric operation have been carried out under his control. He now takes over the corresponding duties on the "tube" lines associated with the Underground Electric Railways Co., Ltd.

Mr. J. P. Thomas, hitherto Superintendent of the Line, London Electric Railway, and now General Superintendent, London General Omnibus Co., having charge of all the work of operation under the general control of Mr. H. E. Blain, Operating Manager, is an electrical engineer by training, and was educated at the Durham College of Science. He served an apprenticeship with Messrs. Clarke, Chapman & Co., Ltd., of Gateshead-on-Tyne. In due course he was appointed Resident Engineer for the British Thomson-Houston Co., Ltd., on their London United and Croydon tramway contracts, being in fact responsible for the equipment of their first consignments of cars. The London United cars were the first electric tramcars in London. Mr. Thomas then became Resident Engineer on the Central London Railway for the conversion of trains from electric locomotive to multiple-unit haulage (these were the first multiple-unit trains in this country); while in connection with the supply and equipment of rolling stock on the Great Northern and City line, his services were transferred from the contractors to the railway. In 1905 he was appointed Superintendent of the Line on the three sections of the London Electric Railway, and in due course he was given similar oversight of the Central London and City and South London tubes when they were taken over by the Underground Electric Railways Co., Ltd.

Mr. H. E. Blain, who has from January 25th been appointed operating manager to the Metropolitan District, London Electric, Central London, and City and South London Railways, in addition to his present appointment as operating manager of the London General Omnibus Co., Ltd., is a comparatively recent addition to the staff of the "Underground" group, having joined it in June, 1913, as purchasing agent, rapidly, however, changing that position in October, 1913, for the post of

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MR. Z. E. KNAPP,
Manager for Maintenance and Construction.

MR. H. E. BLAIN,
Operating Manager.

MR. W. E. MANDELICK,
Secretary and Business Manager.

MR. W. E. BLAKE,
Superintendent of the Line.

MR. J. P. THOMAS,
General Superintendent, London General Omnibus Co., Ltd.

NEW APPOINTMENTS ON THE "UNDERGROUND" SYSTEM.

operating manager of the omnibuses. His previous experience was gained first with the Liverpool Corporation, which, when principal traffic assistant on their extensive tramway system, he left in 1903 to become first tramways manager of West Ham, in which place he was responsible for the organisation of the system. He was a member for several years of the Executive of the Municipal Tramways Association, being President of that body in 1911–12. His name is associated with a number of commercial and other books, one, on "Office Organisation and Management," of which he was joint author with Prof. Lawrence R. Dicksee, F.C.A., having had a very large circulation both in this country and in America.

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PERTINENT PARAGRAPHS

The Annual Reports.

FIRST to come to hand, except for the London and Blackwall, East London and certain other non-operative companies, were the reports of the Great Southern and Western and Great Northern Railways in Ireland. These correspond in every respect with those of last year, the Irish lines not being under the control of the Railway Executive Committee, such work as they have done to meet Government requirements having been dealt with in the usual way. In the case of the English, Scottish and Welsh companies, except certain smaller lines, the reports are necessarily characterised by a large number of omissions. In fact, of the financial tables, besides those relating to capital and expenditure on capital account, the only ones given are those under the headings of (No. 8) Revenue Receipts and Expenditure of the Whole Undertaking; (No. 9) Proposed Appropriation of Net Income; and (No. 18) the General Balance Sheet. The statistical tables are mostly given in full, with, however, a few necessary exceptions. Thus in No. XII., Engine Mileage, particulars of (A) Miles run in relation to the Company's Traffic Receipts, and (B) Miles run in relation to the Company's Expenditure, are "Omitted under authority of the Board of Trade," though details are given of the miles run by engines, rail motor cars, etc. Also the details of passenger and goods traffic (Tables XIII., XIV., and XV.) are necessarily not given.

As an example of the terms in which the Directors set forth the facts of the situation, the following, from the report of the South Eastern and Chatham Managing Committee, may be quoted:

"The Managing Committee desire to state that the normal course of the business of the Committee was necessarily disturbed by the outbreak of the European War in August last. In pursuance of the provisions of the Regulation of the Forces Act, 1871, and the Order of Council of the 4th August made thereunder, the control of the South Eastern and Chatham Railways (as far as they are vested in the Managing Committee by the South Eastern and London, Chatham and Dover Railway Companies (Working Union) Act, 1899), in common with other Railways in Great Britain, was taken over by the Government, for which purpose an Executive Committee was appointed composed of General Managers of certain Companies with the President of the Board of Trade as Chairman."

"It being considered desirable in the interests of all parties that the basis for assessing the compensation payable by the Government under the Act referred to should be determined at the commencement of the period of control, an arrangement was arrived at whereby it was agreed that the compensation to be paid should be the sum by which the aggregate net receipts of the Railways for the period of the Government control fell short of the aggregate net receipts for the corresponding period of 1913, provided that if the aggregate net receipts of the Companies for the first half of 1914 were less than the aggregate net receipts for the first half of 1913 the sum payable should be reduced in the same proportion; the sum so payable as compensation, together with the net receipts of the Railways taken over, to be distributed amongst the Companies in proportion to the net receipts of each Company during the period with which comparison is made."

"The circumstances thus brought about involve special variation in the form of the Accounts and Statistical Returns for the year ended the 31st December, 1914, and the Statements now presented are prepared accordingly."

War Traffic and the Railways.

DURING the latter part of January reports were current to the effect that Waterloo, King's Cross, Charing Cross, Cannon Street, and other large termini were to be entirely closed for public traffic, varying periods, three weeks being a favourite one, being specified. So far there is no suggestion that the demands upon our railways are so severe as this, but a number of notices issued by various railways indicated that important troop movements were in progress. On the North London Railway the through Kew Bridge trains were suspended for part of the day, and reduced at others, the service being partially compensated for by shuttle trains

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connecting with the Richmond trains. There were also reductions on the Chalk Farm and Willesden (Low Level) service. Great Northern and Midland trains were discontinued over the widened lines of the Metropolitan Railway between 10.0 or 10.30 a.m. and 4.30 p.m., and also in the late evening. On the London and South Western Railway the usual services were considerably reduced. But these, and other features peculiar to the situation, were no justification for the more extreme statements referred to above. On many lines where reductions were made, season and return tickets were accepted, while the reductions remained in force, over other railways by which the same journeys could be made.

On the Great Northern Railway, during the early morning, the later morning and afternoon (except on Saturdays), and in the later evening, the Moorgate Street trains were operated to and from Finsbury Park or King's Cross. Certain alterations were made in the main line and Broad Street services to give good facilities between the termini and Finsbury Park, passengers interchanging there. The through Deal, Dover, and Folkestone trains were discontinued. To avoid inconvenience to season ticket and regular travellers, arrangements were made whereby season and ordinary single and return journey tickets became available on the North London and Metropolitan Railways as required.

The Midland Company went even further, issuing new time-sheets showing the services to and from Moorgate Street restricted to about the hours of 7.30-10.30 a.m., 12.30-4.30 p.m. (Saturdays only), and 4.30 to 7.30 p.m. (Saturdays excepted). Similar arrangements with the Metropolitan Company, and in other ways to minimise inconvenience to travellers, were brought into force.

On the South Eastern and Chatham Railway extensive alterations in the suburban services were required in order to remove some of the difficulties incidental to so much extra traffic. An official notification stated as follows: "In consequence of the very large and increasing demands made by the military authorities, it has been found necessary to reduce the passenger train services. The Managing Committee regret the inconvenience to the travelling public, and hope that no further restrictions may be necessary. So soon as it be possible, the cancelled services will be restored."

Commencing Monday, February 8th, to meet the needs of military traffic, considerable curtailment of train services on the Great Eastern Railway came into force, including suburban, cross-country, and main line services, the latter involving in a number of instances the temporary withdrawal of the restaurant cars.

The Railway "Roll of Honour."

THE Directors of the London, Brighton and South Coast Railway have issued a second edition of the Roll of Honour of the Company's men who are serving with His Majesty's Colours The totals are shown in the following table. The statement also shows that up to date forty-three of the Company's employés have given their lives for their country:—

	No. on active service 21 Jan., 1915.
Traffic department	296
Goods department	171
Locomotive department ..	490
Carriage and wagon dept. ..	246
Electrical department ..	85
Engineering department ..	462
Marine department	75
Other departments	70
Total	1,895

On page 234 is reproduced a poster issued by the London and South Western Railway and exhibited at the railway stations. The total of 2,406 now stated is made up as follows:

Carriage and wagon dept. ..	313
Docks and marine department ..	239
Engineer's department	531
Goods department	154
Locomotive department ..	669
Traffic department	403
Other departments	97
Total	2,406

Of these 29 have given their lives on active service.

Troop Traffic Under War Conditions.

SIR H. A. WALKER'S statement that the First Expeditionary Force had involved the working of about 350 trains averaging 30 vehicles each, has apparently caused some mystification among ordinary readers, some of whom have, apparently, imagined that these might be made up of modern bogie coaches, obviously an impossible and impracticable load even for our most powerful locomotives. Possibly the load stated is occasionally reckoned on the "=to" principle; but the real explanation is that the general policy has been to convey the troops in complete units, each party taking with them horses, guns, stores and equipment. Hence a usual make-up has been three or four bogie coaches, ten or fifteen horse-boxes and cattle trucks for the horses—these have sometimes been conveyed in open wagons—and fifteen or twenty flat, open and miscellaneous wagons for guns, stores, camp equipment, ammunition, etc. On this basis it will easily be understood that 30 vehicles makes quite a practicable train load to be worked at moderately fast speed by mixed-traffic 4–4–0 or express goods locomotives. Moreover, as frequently only about 200 men were conveyed per train, varying, of course, according to whether cavalry or infantry are concerned, the large number of trains required is explained.

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Special Provision at Railway Stations for Soldiers.

BESIDES the various special arrangements made for dealing with military traffic on the railways, at many stations accommodation for rest and refreshment is now made for soldiers arriving by or waiting for trains. At Victoria station a room has been fitted up as a soldiers' buffet for the free supply of tea and coffee to the men returning to the front and waiting for the morning troop trains. Ladies of the British Red Cross Society attend at the station sufficiently early to provide hot drinks for the men by 6.30 a.m. At the northern termini the need of early morning rest rooms is not so urgent, for the soldier heads at once for Victoria if he arrives in the early hours from the north. At Euston, however, where tea and coffee are supplied free, admission can be obtained to the soldiers' and sailors' rest room as early as 7.30 a.m.

At Waverley station, Edinburgh, soldiers and sailors passing through have been served with tea and coffee and pies since November. Ladies are on duty from 10 a.m. till 11 p.m. daily. The Red Cross room at Waverley is open day and night, but is for wounded only. The general waiting room is open all night and has a blazing fire. The first tea-barrow goes round at a quarter to 6 in the morning.

At Perth General Station arrangements are in operation for the free supply of tea and food for the soldiers and sailors who have travelled North overnight. Teachers of the schools take the duty from 5 till 6 in the mornings, and a band of ladies from 9 o'clock. Only the through trains are met. This work is arranged for by the Patriotic League of Perthshire. Beside these ordinary trains, troop trains are attended to by another organization.

German Railway Preparations.

IT does not always do to accept everything that is published concerning the war and events which preceded it as entirely trustworthy, but there is a suggestion of probability about aspects referred to by a writer in a recent issue of the *Contemporary Review* that renders reference thereto of interest. Speaking of elaborate track and yard accommodation on the German lines the author, Mr. Roy Norton, mentions that he observed many "switch" or "shunting" yards "capable of entraining tens of thousands of soldiers in a few hours, yards where from ten to twenty passenger trains could be drawn up at one time, and, oddly enough, some of these queer yards, all equipped with electric lighting plants, are out in places where there are not a dozen houses in sight. In some of these yards, located at central points for rural mobilisation, one saw long trains of troop cars, dingy, empty, stodgily waiting for use in war, if one ever came. I was told of one test mobilisation (in reply to my query as to why I had seen so many troops pass through a small place one evening), where twenty thousand men were assembled at ten o'clock one morning, made a camp complete, were reviewed, entrained, detrained, and just seven hours later there was nothing save *débris* and trampled grass to show that the place had ever been disturbed."

War Locomotives.

CONTINUING, Mr. Norton states that at a mere "Tank station" below Kriesingen, on June 12th, 1913, he saw "probably seventy-five or a hundred locomotives (I had time to count more than seventy), most of which were of antiquated type, obsolete as far as the demands of up-to-date traffic are concerned, and of a kind that would have been 'scrapped' in either England or America. Yet these were all being cared for and 'doctored up.' A few engineers and stokers worked round them, and I saw them run one down a long track and bring it back to another, whereupon hostlers at once began drawing its fires, and the engineer and stoker crossed over and climbed into another cab."

"'What do you suppose they are doing that for?' I asked one of the train men with whom I had struck up an acquaintance."

"'Why,' replied he with perfect frankness, 'those are war locomotives.'"

"Reading the look of bewilderment on my face, he added: 'You see, those engines are no longer good enough for heavy or fast traffic, so as soon as they become obsolete we send them to the reserve. They are all of them good enough to move troop trains, and therefore are never destroyed. They are all frequently fired up and tested in regular turn. Those fellows out there do nothing else. That is their business, just keeping those engines in order and fit for troop duty. There are dozens of such depôts over Germany.'"

"'But how on earth could you man them in case of war?—where would you get the engineers for so many extras?'"

"He smiled pityingly at my ignorance."

"'The headquarters know to the ton what each one of those can pull, how fast, where the troop cars are that it will pull; and every man that would ride behind one has the number of the car he would ride in, and for every so-many men there is waiting somewhere a reserve engineer and stoker. The best locomotives would be the first out of the reserve, and so on, down to the ones that can barely do 15 kilometres per hour.'"

"Since that June day Germany has proved how faithfully those thousands of reserve locomotives over her domain have been nursed and cared for, and how quickly those who were to man and ride behind them could respond."

The Value of Portable Railways.

ON this subject, too, Mr. Norton has something to say:—"On February 14th of this year, I was in Cologne, and blundered where I had no business, into what I learned was a military-stores yard. Among other curious things were tiny locomotives loaded on flats, which could be run off those cars by an ingenious contrivance

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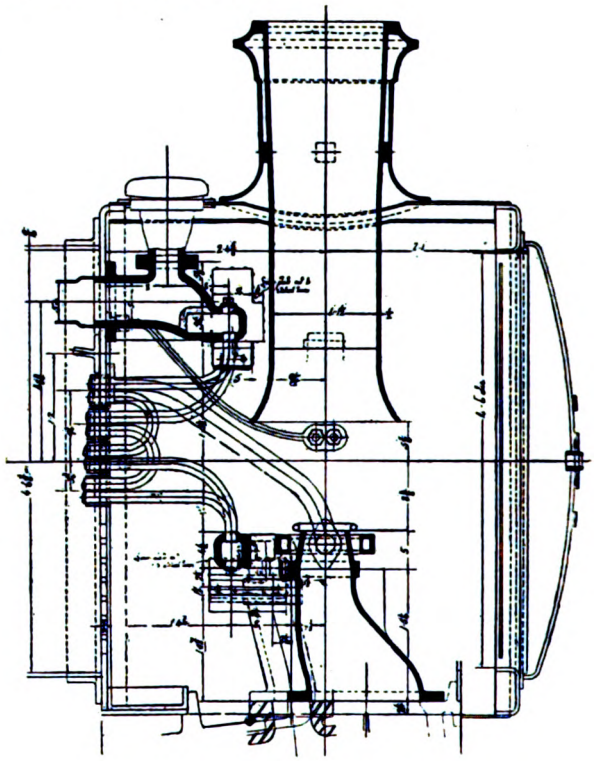
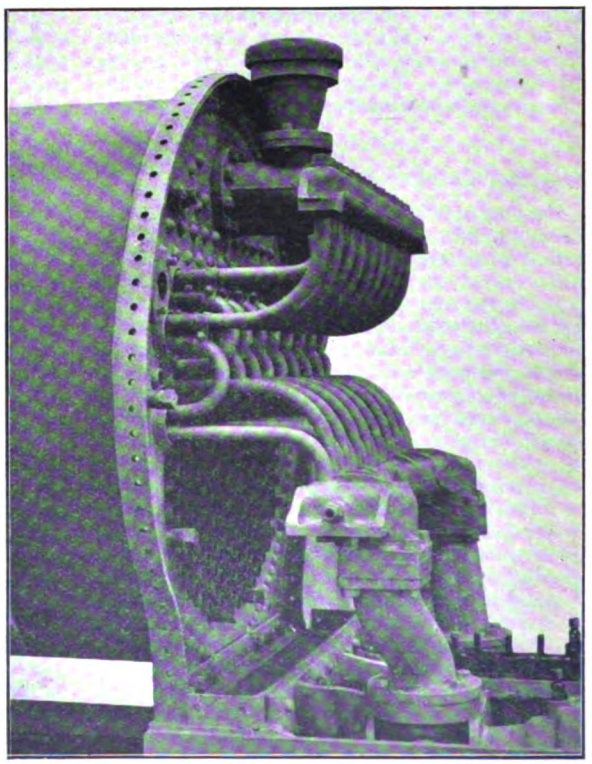
of metals, or, as we call them in America, rails. Also there were other flats loaded with sections of tracks fastened on cup ties (sleepers that can be laid on the surface of the earth), and sections of miniature bridges on other flats. I saw how it was possible to lay a line of temporary railway, including bridges, almost anywhere in an incredibly short space of time, if one had the men. At one period of my life I was actively interested in railway construction, but had never before seen anything like this. Before I could conclude my examination I discovered that I was on *Verboten* ground, and had to leave ; but the official who directed me out told me that what I had seen were construction outfits. The more I thought of those, afterwards, the more I was puzzled by the absence of dump cars, and that mass of smaller paraphernalia to which I had been accustomed in all the contracting work I had ever seen. Yet I had to remember with admiration the ingenuity of the outfit, and think of how quickly it could all be laid, transferred, reshipped, or stored."

He then quotes a letter from a Dutchman who returned home from Germany on August 30th, after trying experiences, and this communication is quite interesting enough for reproduction as follows :—"Never, I believe, did a country so thoroughly get ready for war. I saw the oddest spectacle, the building of a railway behind a battlefield. They had diminutive little engines and rails in sections, so they could be bolted together, and even bridges that could be put across ravines in a twinkling. Flat cars that could be carried by hand and dropped on the rails, great strings of them. Up to the nearest point of battle came, on the regular railway, this small one. It seemed to me that hundreds of men had been trained for this task, for in but a few minutes that small portable train was buzzing backwards and forwards on its own small portable rails, distributing food and supplies. It was great work, I can tell you. I've an idea that in time of battle it would be possible for those sturdy little trains to shift troops to critical or endangered points at the rate of perhaps 20 miles an hour, keep ammunition, batteries, etc., moving at the same rate and, of course, be of inestimable use in clearing off the wounded. A portable railway for a battlefield struck me as coming about as close to making war by machinery as anything I have ever heard of. I did not have a chance, however, to see it working under fire, for, being practically a prisoner, I was hurried onward and away from the scene."





MR. GRESLEY'S "TWIN-TUBE" SUPERHEATER: GREAT NORTHERN RAILWAY.

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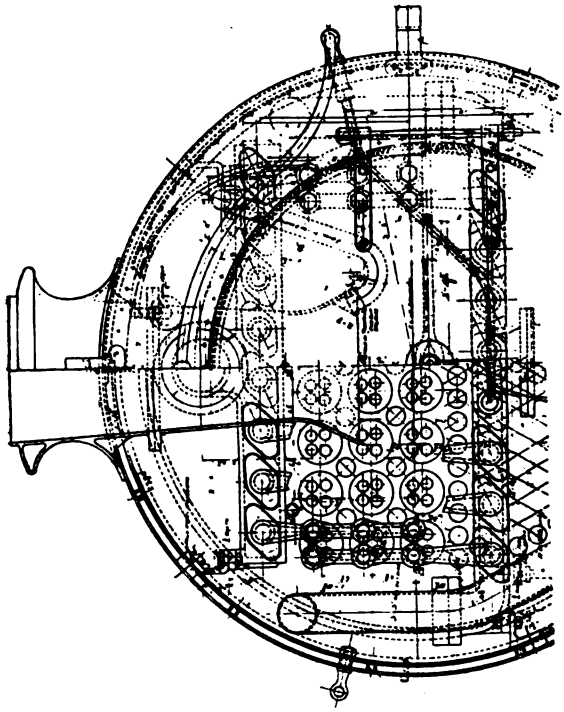
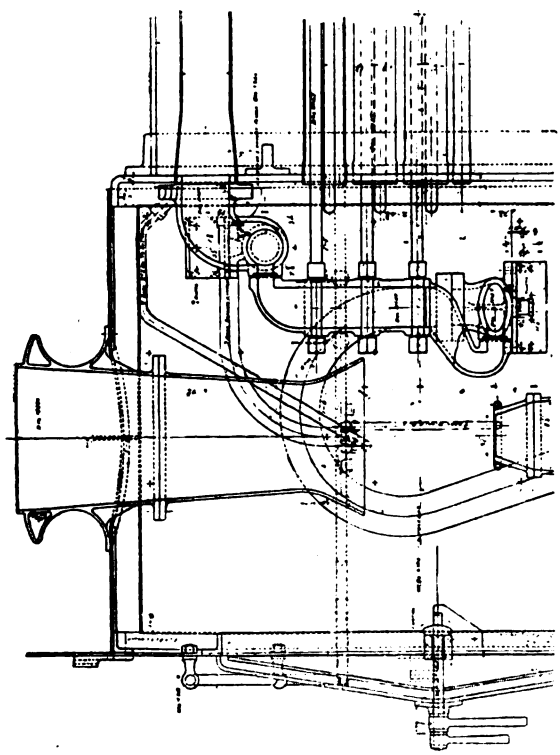


MR. W. R. URIE'S "EASTLEIGH" SUPERHEATER: LONDON AND SOUTH WESTERN RAILWAY.



Developments in Locomotive Superheater Design.

MR. H. N. GRESLEY on the Great Northern Railway, and Mr. R. W. Urie on the London and South Western Railway, have introduced new superheater designs for use on their locomotives. Both are of the return tube type, and both use top and bottom headers respectively for saturated and superheated steam; but otherwise there is little similarity between the two designs. By the courtesy of the gentlemen named we are able to illustrate these new superheaters.

Mr. Gresley uses two simple cast-iron headers, the upper one, for saturated steam, connected with the main steam pipe from the dome, and the lower one, for superheated steam, in communication with the steam pipes leading to the cylinders. Between them the superheated elements are constituted on a system of "twinning," so arranged that any tube can be removed or dealt with without reference to any other tube. There are four rows of large fire-tubes, 4 in. diameter as against the usual 5 in. or 5¼ in., eight in the first and third rows and nine in the second and fourth rows, and the elements are so arranged that while one runs from the upper header to the second row of tubes, making only a two-fold steam path therein, thence passing to the corresponding tube in the fourth row, where a second two-fold steam path is given, after which the steam passes to the lower header, the next is similarly arranged with reference to the first and third rows of tubes. The usual practice of a four-fold steam path is thus maintained, but with smaller large tubes, and with seventeen complete superheater elements.

Mr. Gresley states that with this design he obtains about 10 per cent. water tube heating surface more than with the usual types, the heating surface of the elements being the same in each case. The superheater tubes are expanded into the headers in the usual way. Mr. Gresley's arrangement has the advantage that it leaves wider bridge pieces between the tubes owing to the smaller diameter of the flue tubes. On the upper header will be noted a 4-in. anti-vacuum valve. No damper mechanism is employed.

Mr. Urie is fitting his superheater to several 4–4–0 and 4–6–0 locomotives. In this design the headers are connected by a system of small vertical headers, those from the saturated steam header connecting with the inlet ends of each superheater element, and those from the superheated steam header with the outlet ends thereof.

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In each large firetube there are four tube lengths as usual. The superheated steam header is carried by bracket supports with long swan-neck connections with the steam pipes. There are 21 5¼ in. large firetubes and 138 1¾ in. small tubes in the boiler illustrated. The vertical headers form a grid system, which is stated to act very much as a spark arrester. A steam circulation system is fitted instead of damper mechanism.

Reminiscences of a Railway Veteran.

At the Railway Institute, Willesden Junction (London and North Western Railway), a presentation was made to Sir Robert Turnbull (President of the Institute and late General Manager of the Company). Among those present were: Major G. N. Ford (Superintendent of the Southern Division of the Line, who was in the uniform of the London Scottish); Mr. E. C. Grindley (Assistant Superintendent of the Line), Mr. C. L. Sharratt (Superintendent of the West London Extension, Kensington), Mr. F. Dingley (Motor Superintendent, Crewe), Mr. F. J. Bradford (Assistant Superintendent of the Southern Division), Mr. P. Skipworth (Publicity Department), and Mr. F. Hare (Advertising Department). After acknowledging the presentation, Sir Robert gave some interesting reminiscences from his long railway career. He joined the London and North Western Railway some 47 years ago, when things were somewhat different to what they were to-day. He had been on the outdoor staff all his life, and was thus not intimately acquainted, until recent years, with the work of the indoor staff, though, of course, he knew a good deal about it. When he joined the railway there was no block system in existence. There were men stationed along the line at intervals of a mile or two miles, and they had either red or green flags, and red or green lamps which they used to wave as the trains were approaching, and a similar process was adopted when the next train came along. After that a sort of block bell was introduced, which was a kind of continuous clanging bell used for the purpose of signalling the approach or departure of trains. Then very many years elapsed before they got the absolute block system all along the line. When he went to Liverpool in 1872 there was a block system on the main line, but certainly not on most of the branches. It might, therefore, be imagined that accidents were somewhat frequent in those days. Then there were main line trains running with very poor accommodation, and foot-warmers were at a premium, although it was possible to obtain them occasionally from a porter for a consideration. In these days it was really very difficult for those who had not experienced them to believe in the discomforts which passengers then had to go through. Then, again, the lighting was extremely bad. Oil lamps were used, and those who could afford it purchased reading lamps, which could be attached either to the window or to a part of the carriage which was most convenient for the passenger who desired to read. He possessed one of these oil lamps now, and looked upon it as a great curiosity. Then, again, in the early days of this service the system was worked with very considerable difficulty. They did not possess enough accommodation, nor sufficient sidings, and between London and Carlisle he remembered having to be content with simply one up and one down line. After this came lines of sidings, and other necessary accommodation for working the line followed. Then, again, at Crewe the lines were frequently in a state of block, but the staff were always willing to do everything they could to facilitate the carrying on of the traffic. They were pretty good chaps in those days. They did not bother as to whether they worked eight hours or ten hours—they would work for as many hours as they were capable of doing with a view of getting the traffic through. In saying this, he did not mean to insinuate anything against those who were working for the company to-day, for even now they were all good fellows as they were in the days to which he had referred. He merely mentioned it to show what changes had come about during his time.

Mr. Asquith on the Railway Situation.

Speaking in the House of Commons recently the Prime Minister referred in detail to the services rendered by the railways to the nation, and to what their temporary incorporation as a Government Department has entailed. He pointed out that they have had to carry increased quantities with decreased facilities; that they have constant calls naturally from the military and have to be in a position at all times to provide whatever the military movements may require. During the last six months, to take only one illustration, the London and North Western Railway Company alone has run 7,000 special military trains. That is apart from goods trains. In reference to the alleged inadequacy and congestion of transport in reference to food stuffs and general traffic Mr. Asquith stated that "special facilities are now given to ensure the free and continuous movement of foodstuffs and perishables, which have hitherto been congested and mixed up with the ordinary traffic. They now get priority. Of course the Government and Government contractors' traffic has the first claim, but, subject to that the companies act in concert and assist one another with rolling stock and engines. Goods wagons have now been pooled, and payment of demurrage has been experimentally suspended. That is a very important item. A committee of experts has been set up specially to deal with all problems arising out of actual or possible railway congestion. Information is obtained daily by this committee as to the requirements of each company and as to difficulties that are likely to arise. Steps are then taken to render assistance; traffic is diverted, if necessary, from one route to another; the provision of emergency works, such as sidings, special lines, and so on is recommended when necessary, and redundant passenger facilities are curtailed to give greater accommodation to goods traffic.

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These efforts on the part of the companies have already produced a most sensible and growing amelioration."

What the Great Eastern Railway has done.

SPEAKING at the annual meeting of the Great Eastern Railway Company, Lord Claud Hamilton gave some interesting details of special traffic carried to the order of the Government since the outbreak of war. He said: "We have run, from August until the end of December, 2,793 special military and naval trains—an average of fifteen special trains per day—in addition to the carriage of numerous isolated bodies of troops. Our hotel at Harwich has been converted into a military hospital, and an excellent one it makes. The great quay at Parkeston, usually devoted to the Continental traffic, has been handed over to the Admiralty, with the exception to two berths, and it has proved invaluable for naval purposes. . . . Our hotel at Parkeston has been run at very low prices, in order to be within the reach of naval and military officers who are employed in the vicinity, as well as their wives and relatives. Many of our best steamers have been requisitioned by the Government, and at present we have five under Admiralty control. Having regard, however, to the great importance of maintaining an adequate supply of the necessaries of life, in this country, we are still running three cargo boats every week between Holland and Parkeston for the conveyance of foodstuffs. . . . Out of our staff, numbering some 33,000, 3,600, or more than 10 per cent., have joined the Colours. About fifty of these at the front have already, I am sorry to say, been killed, but we, of course, on your behalf, are looking after the dependents of these men. . . . From the highest to the lowest all the railway staffs in Great Britain have worked with a will, and all for the common good."

Special Traffic on the Great Northern Railway.

AT the Great Northern Railway meeting, Lord Allerton dealt with other aspects of the special traffic associated with war conditions. "We have practically placed our manufacturing establishments at the disposal of the Government wherever they could be utilised in order to assist the Government and the War Office and Admiralty in providing tools and materials and necessaries for the services, and that has occupied a considerable portion of the time of our men. . . . As to delays on the railways, and so on, as regards the traffic, all I can say is that any delay which has arisen on our railway has been from circumstances over which the staff have had no control. We have been inundated with certain kinds of traffic at the London end. At the London end we have been asked to carry goods from the docks as soon as we could get them, but we have not been able to get them so quickly on all occasions as we might desire. As a Company, we have dealt with and handled more wagons at the London end than have ever been handled at any previous time in the history of the Company, and any delays that have occurred have been beyond our control. We are giving preference to food and fuel, which is necessary to daily life. . . . I think that we have now mastered the main difficulties, and the docks and the Port of London are getting more under control than they were. The people of Bradford, who are dealing with large quantities of wool for making Army clothing, have also been very urgent in their requests with regard to the carriage of their goods. It is to be remembered that we have had a considerable number of men who have joined the Colours and enlisted, which has shortened the staff."

South Eastern and Chatham War Traffic.

IN the course of his remarks at the meeting of the South Eastern Railway, Mr. Cosmo Bonsor said: "The Executive Committee have had great responsibilities thrown upon them, and the work they have done has been, I might say, extraordinary. During the first week or ten days I can tell you that not a single body of troops waited for a train. The train was always ready to wait for the troops, and the trains when they started always ran up to the schedule of time. Now, that would not have been possible had there not been great inconvenience caused to several passengers. At one time on our system it almost looked as if we should have to suspend the passenger traffic. Happily we were able with a restricted service to carry out the business of our Company. . . . As regards the Executive Committee, very heavy responsibilities have been thrown upon individuals, and I ought here to mention that our general manager, Mr. Dent, owing to the fact of our close connection with the foreign railways, the Chemin de Fer du Nord and the Belgian State lines, has had special responsibilities thrown on him."

War Traffic on the Great Southern and Western Railway.

AT the shareholders' meeting of the Great Southern and Western Railway, Sir William J. Goulding gave noteworthy details of work done on his line. "During the past half-year, during the mobilisation of the Expeditionary Force from August 5th to August 21st, they carried in 172 special trains 60,000 men, 10,000 horses, 200 trucks of baggage, and 1,100 wagons of guns, etc., although they had received no guarantee of subsidies, as the English companies had had when taken over by the Government. They had turned out at their Inchicore Works for the War Office to December 31st, 1914, an ambulance train, and as soon as this had been completed an order was given by that Department for 90 general service transport wagons, and these had been delivered, in addition to supplying axles and brasses to other Irish railway companies, who received orders for similar wagons, and also 149 sets of axles, 116

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sets of pipe boxes, 67 sets of wheels, 32 sets of draught poles, while they had an order now in hands for 45 water tank carts, 7,000 picket pegs, and 400 picket pegs.

The Great Northern Railway of Ireland's Share of War Traffic.

In the case of the Great Northern Railway of Ireland, which is not included in the Government guarantee, and is therefore not under the immediate control of the Railway Executive Committee, Mr. Fane Vernon, Chairman, stated that: "At the request of the War Department this Company has fitted up and equipped an ambulance train, composed of nine bogie vehicles, with a total length of nearly 500 ft., which is being used for the conveyance of wounded soldiers. The work of adaptation of the rolling stock to this purpose cost about £1,300, and for the time being, its use leaves the Company somewhat short of vehicles of a certain type; but it was our duty to do all that we could to facilitate the authorities at this crisis. This and other work which we are carrying out for the Government at Dundalk has kept our works busy. . . . Of our comparatively small staff 316 are now serving their King and country with the Colours.

Miscellaneous Items of War Interest.

On Sunday, January 31st, the Kingstown mail boat *Leinster* was chased by a German submarine, while on her voyage across the Channel. The following day it was announced that owing to the presence of a German submarine in the Irish Sea, the City of Dublin Steam Packet Company had abandoned for the present their sailings with Belfast, Liverpool, and Glasgow. The mail boat left Kingstown that morning, but the London and North Western Railway cancelled the sailings of all their steamers from North Wall. On the Tuesday almost all the regular sailings from Dublin were resumed. The Heysham steamer left Belfast on Tuesday afternoon, being the first to leave that port since Saturday. One route was open all the time between the North of Ireland and Great Britain —the Larne and Stranraer service, passengers from as far south as Dublin utilising that service. On the Tuesday passengers arriving at Holyhead for Dublin and Greenore were allowed to cross on the mail boat to Kingstown. The following day most of the steamship companies in Dublin, including the London and North Western Railway, resumed their full sailings, and on Thursday night the boats of all the companies put to sea.

On behalf of the Belgian and French Governments, Capt. Robert Carey, of the Channel mail steamer *The Queen*, was recently presented with a handsome pair of marine glasses. A silver plate bore an inscription appreciative of the rescue of 2,200 refugees from the liner *Amiral Ganteaume* when she was torpedoed in the Channel by a German submarine. Mr. Herbert Chapman, Chief Engineer, was presented with a silver inkstand in the form of a Belgian carillon. Capt. Bultinck, Belgian States Marine Inspector, pointed out the danger which *The Queen* ran of being torpedoed when transferring the passengers, and said that Capt. Carey's conduct had excited admiration in all maritime circles. He paid a high tribute to the work of the South Eastern and Chatham Railway officials at Folkestone in dealing with the Belgian refugees during October, and gratefully acknowledged the courtesy and sympathy of the officials of the line. Capt. G. F. Dixon, Marine Superintendent at Folkestone, replied for the company.

A special badge is being issued to railwaymen of military age who are desirous of enlisting, but who cannot be spared from the railway companies' staffs. Having in view the many statements made by authoritative persons that railwaymen are serving their country equally as well, if not better, by remaining at their posts of duty than by joining his Majesty's forces, it is considered desirable that all such men should be in possession of something which will indicate the importance of the service to which they belong, and to which they have so faithfully rendered their duties in these times of stress, and such a badge will fulfil this object.

The Baldwin Locomotive Works have secured from the French Government an order for 100 locomotives for early delivery. The engines are designed for working on a 60-cm. grade, and the design is based on what is known as the Péchot type, which is a modification of the Fairlie double-ended system, and very similar to the type already in use on the Northern Railways of France. The order was secured through the London office of the Baldwin Company.

We understand that Mr. J. Gurney Fowler, senior partner of the firm of Messrs. Price, Waterhouse & Co., Chartered Accountants, has been appointed Consulting Accountant by the Government in connection with the compensation payable to the railway companies whose undertakings have been taken over by the State during the period of the war. Some of the railway companies are constructing heavy guns in their erecting shops, to the order of the Government.

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FIRST of the railway annual meetings for this year, that of the East London Railway enabled the Chairman, Lord Claud Hamilton, M.P., to combine a favourable report of the year's working, with appreciative remarks in reference to the services rendered by railwaymen to national requirements. In introduction, Lord Claud remarked: "I feel sure the shareholders of this Company, as well as the shareholders of all railways in Great Britain, are proud of the manner in which the staffs of their several companies have responded to the call of the country, and have gone to the front to serve their King during this terrible European War. Our staff is but a small one, and it is not under the control of this Board, but it may interest you to learn that as we have very near relations with the Great Eastern Railway, that of the staff of that Company no fewer than 3,600 men have gone to the front, which represents more than 10 per cent. of the total staff, and when you consider that of that total staff there are at least one-third outside the age for military service, I think you will see the percentage is very large. I am sorry to say that out of those 3,600, forty-six have already been killed in action. I believe that the attitude of the staff of the Great Eastern Railway only exemplifies what has been done by the staffs of all the other railway companies. and I am proud to think that our staff has responded to the call made upon them in the manner that they have done."

During the year ending December, 1913, receipts were £46,215, as against £38,009 in the year 1912, which shows an increase of £8,206. Owing to the railway being, like other railways, under Government control, it has been impossible to furnish any data as to receipts during the past six months, but a statement of the number of passengers carried during the past year can be given. During that year the number of passengers carried was 6,172,121, as against 5,149,064 in the year 1913, a fairly satisfactory increase of 1,023,057 passengers. On week-days there is a service between New Cross and Shoreditch of 140 trains daily each way, making a total of 280 trains a day. Then, there are 74 trains each way between New Cross station and Hammersmith on the Metropolitan Railway, while the Sunday service shows that from New Cross to Shoreditch there are 63 trains each way, and from New Cross to Hammersmith, *viâ* the Metropolitan Railway, there are 57 trains each way. Up to the end of July, when the war broke out, goods and mineral traffic was very satisfactory; but, as the report states, since the beginning of August, although we have carried a large traffic for the Government, the ordinary goods and mineral traffic has been very much interrupted. As to the erection of the lifts at Wapping, which has a strong bearing upon the results of the adoption of electricity on this line, these lifts would, under ordinary circumstances, have been completed by this time, but owing to the requirements of the Government the contractors who were supplying the material had to apply all their energies in the interests of the Government. The work, therefore, has been delayed, but it is hoped that these lifts will be in working order at an early date.

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PRIZES and certificates gained by the students attending the Lancashire and Yorkshire Railway School of Signalling during the session 1913–14 were presented on January 28th by Major A. Watson, Superintendent of the Line, in the Albert Hall, Manchester. Major Watson was supported by Mr. W. H. Coomber, Assistant Engineer; Mr. J. Taylor Jones, Assistant Solicitor; Mr. S. Hauxwell, Assistant Superintendent; Mr. J. H. Burman, Assistant to the Superintendent of the Line; Mr. W. H. Pearson, Chief Clerk, Office of Superintendent of the Line; Mr. A. Davies, Lecturer to the School of Signalling; and others. He referred to the great interest taken in the School by Mr. John A. F. Aspinall, the General Manager, who was unavoidably prevented from presenting the prizes by other duties in London. Major Watson pointed out that owing to the war the chief officers of the Company could not do as they did in peace time and order their goings as they might otherwise do. The number of members attending the classes was well maintained, and it was gratifying that members coming to the earlier stages of the classes apparently became fascinated by their studies and continued to attend the classes to the honours grade. This shewed that the men on the Lancashire and Yorkshire Railway were taking a lively interest in the performance of their work. Major Watson also referred to the fact that a number of students had joined the Forces, and were unable to be present to receive their prize or certificate on this account. One hundred and seventy-eight men obtained certificates or prizes, ten in the Honours class, seventeen in class "A" (advanced), fifty-nine in class "D" (signalmen), thirty-seven in class "E" (Intermediate), and fifty-five in class "F" (elementary).

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On January 28th the chief officers of the London and South Western Railway entertained Sir Herbert Walker at the Criterion Restaurant, to celebrate the honour of Knighthood recently conferred upon him by his Majesty the King. Mr. Bishop, Solicitor, in proposing the toast of the evening, warmly congratulated Sir Herbert upon the distinction he had gained, and observed that the honour conferred upon him was received with the greatest satisfaction in all quarters and was the source of the utmost pleasure to all the staff of the Company. It was one, too, which he had every reason for believing the travelling public considered was never more richly deserved. He dwelt upon the invaluable service rendered by Sir Herbert to the country in connection with his work on the Executive Committee of Railway Managers, and the admirable way in which he had conducted the proceedings of that important body during the crisis through which the country and the railways had been passing in connection with the war, and concluded by wishing Sir Herbert, on behalf of himself and his brother officers, a long and happy life to enjoy the distinction conferred upon him. The toast was received with enthusiasm. Sir Herbert, in responding to the toast, made a very graceful speech, acknowledging the unstinted help he had received from all the officers, and, indeed, all the employees of the Company, during the trying times through which the country and the railways had been passing. He gave an interesting *resumé* of the work of the Railway Executive Committee since its inception, and reminded the officers that although the railways had done great things in the conveyance of troops, etc., since the outbreak of the war, they had still more stupendous tasks before them.

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At the January meeting of the Railway Clearing House Superintendents' Conference, Mr. F. G. Randall, who recently retired from the position of Superintendent of the Great Eastern Company, was presented with a testimonial, consisting of a silver bowl and plinth and a clock, which had been subscribed for by the members of the Conference. Mr. Arthur Watson (Lancashire and Yorkshire Railway), Chairman, made the presentation, and asked Mr. Randall to accept the articles as a mark of the appreciation his colleagues entertained of his business capacity, and of their esteem for him personally. Concluding, he wished Mr. Randall long life in which to enjoy the leisure to which his arduous railway service so fully entitled him. Mr. Cockburn (Glasgow and South Western Railway), the senior member of the Conference, endorsed all the remarks of the Chairman, and mentioned that Mr. Randall, during his long service with the Great Eastern had acquired practical knowledge in all the higher branches of outdoor working. Mr. H. A. Watson (North Eastern Railway) and Mr. Wm. C. May (Great Eastern Railway) associated themselves with the remarks of previous speakers.

The death of Mr. J. F. S. Gooday removes another of the last generation of distinguished railwaymen. He had been connected with the Great Eastern Railway for more than 40 years before he became General Manager. He was an East Anglian, born at Chiltern, in Suffolk, in 1847.

In 1863 he joined the Great Eastern Railway, and at the end of six months' probation received an appointment in the office of the Manager, Mr. Moseley, at the old Bishopsgate Street station. After making himself acquainted with the practical working of the railway at various stations, he went to Leeds in 1869 to assist Messrs. John Pepper & Co., who were then the cartage agents to the company in Yorkshire and Lancashire, and on the company taking over the cartage themselves returned to London, and was placed in charge of the goods claims department.

In 1877 he was appointed Assistant Continental Manager, and in 1880 was given the control of the department. In 1898 he left the Great Eastern Railway to undertake the management of the London, Brighton and South Coast Railway. He left that railway in 1899 to return to the Great Eastern as its General Manager. In appreciation of his services in developing the traffic between England and the Continent, Mr. Gooday was created Knight of the Orders of the Dannebrog, Denmark; Michael, Bavaria; Ernestin, Saxe-Coburg; and Chevalier of the Order of Leopold, Belgium. He also took an active interest in railway work outside his ordinary duties, and was well known in the Committee Rooms of the two Houses of Parliament, having frequently given evidence on important Bills. He was a Lieutenant-Colonel in the Engineer and Railway Staff Corps, and was chosen from amongst that body to serve on the late War Railway Council.

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Preparations have been made on the "tube" railways whereby the advantages of underground safety afforded thereby may be rendered available for the general public, without the risks of panic and dangerous pressure which may easily arise should there be a rush to the "tube" stations in the event of an "air raid" over London. Gates have been erected so that entrance may be regulated in the interests of general safety, while telephone equipment will enable the underground and surface staffs to communicate with a view to proper co-ordination. Already the lighting circuits are distinct from the traction circuits, and in some cases connections are available whereby lighting current may be obtained from more than one source. There are also emergency battery lighting equipments on the trains, so that there is very little possibility of an entire breakdown of the lighting supply. The "Ozonair" equipments, and the ventilating fans installed here and there also provide for a proper circulation of air should it become necessary to utilise the low level tubes and subways in this way.

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We regret to record the death of Mr. H. T. Jackson, General Passenger Agent, Midland Railway. Mr. Jackson entered the Company's service at Derby in January, 1872, as a junior clerk in the department of the Superintendent of the Line (commercial section), and passed through various grades, gaining a thorough practical knowledge of the working of the department. Mr. Jackson was appointed to his latest position on April 19th, 1912, in succession to Mr. E. R. Ward.

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Mr. H. Deans, M.A., M.Inst.C.E., who has been the Great Western Railway Assistant Stores Superintendent since 1910, has been appointed by the Directors to the position of Stores Superintendent, in succession to Mr. W. H. Stanier, who relinquishes the position but will remain attached to the General Manager's office at Paddington as an Assistant to the General Manager. Mr. Deans, who was born in 1865, had considerable engineering experience in this country and in South America before he became associated with the Great Western Railway, which was in 1900. Among the important works which he superintended were the Chester Joint railway station extension, the Electric Construction Works at Wolverhampton, the City of Buenos Ayres Improvement Works, construction of bridge work on the railway between Tottenham and Forest Gate, construction work on the Great Central Railway and widening and reconstruction of bridges on the South Eastern and Chatham Railway between London and Orpington. His first position on the Great Western Railway was as principal assistant in charge of the Ironwork Department, when he dealt with all steel bridge and structural work on the system. In 1903 he was appointed Assistant to the General Manager. In 1910 he became Assistant Stores Superintendent, which position he occupied until his recent promotion.

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A hitherto unsuspected relation to art is now claimed for the railway ticket, seeing that the backs of the tickets issued by the Metropolitan Railway are being illustrated by a variety of designs expressly drawn by John Hassall. A new poster, "It's a pity to puncture the Picture," also by Hassall, where the artist manages to insinuate a subtle compliment to himself, is now on view at all Metropolitan Railway stations. The Hassall drawings are employed in connection with approved advertisements which the Metropolitan Company have arranged to have printed on the backs of all their tickets. Although the idea of utilising railway tickets for publicity purposes is not absolutely new, the combination of art and advertising in the manner now proposed and in conjunction with posters is quite original. It was initiated by Messrs. S. Davis & Co., of 30–31, St. Swithin's Lane, E.C., who have been appointed sole agents for advertising on the tickets of the Metropolitan Railway.

Which School Shall it Be? Under this title Mr. H. J. Jewell, Advertising Department, Great Northern Railway, has issued a handy guide to schools of repute served by the Great Northern Railway and its connections. The booklet deals also with the health and other attributes of the districts where the schools mentioned are situated. The Great Northern Railway and its connections serve thousands of miles of territory where there are good schools, and the success attained by the majority of them testifies to their own merit and to that of the places in which they are situated. Particulars are given of a number of these schools which have been approached by the Great Northern Railway. Copies of this guide can be obtained on application to the Superintendent of the Line, Great Northern Railway, Advertising Department, 3, York Road, King's Cross, London, N.

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A halt, for the accommodation of soldiers at Ballykinlar Camp, has been erected by the Belfast and County Down Railway between Tullymurry and Dundrum stations. Important improvements have been carried out at Bangor station. Accommodation in the goods yard at Downpatrick has been increased. For the

ART AND THE RAILWAY TICKET.
An effect anticipated by Mr. John Hassall.

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traffic between Newcastle and Kilkeel, an additional road motor and trailer have been purchased. Two passenger locomotives have been practically rebuilt, and the cost charged to revenue, while three six-compartment six-wheeled third-class carriages, and one six-wheeled second and third class composite carriage have been built as renewals of stock in place of four four-compartment four-wheeled carriages, and the cost of these, as also of 33 goods wagons, have been charged to revenue. Mr. J. W. Manning has been appointed hotel manager to the Belfast and County Down Railway in place of Mr. W. F. Collins, resigned.

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ENGINEERING works on the Highland Railway completed during 1914 include the widening of the line from Bunchrew to Clunes, opened for traffic on June 1st, 1914, and new sidings, at Redburn, between Munlochy and Allangrange, for timber traffic; at Tarvie, between Achterneed and Garve; at Calbruar, between Blair Atholl and Struan; for the better working of heavy traffic at Luib Summit, between Achnashellach and Achnasheen; and for the Burgh coal traffic at Inverness under an agreement with the Town Council. A block of four workmen's houses at Kingussie has now been completed, and another block of four at Boat of Garten is ready for occupation, as is also a block of two houses at Orbliston Junction. A block of four houses is in progress at Alves Junction. The dwellings at Altnagourach, south of Dalnaspidal station, having been burned down, a block of four houses has been built in replacement of them, and is now ready for occupation. The loss incurred by the accident at Carr Bridge in June amounted to over £7,000, and to meet this £2,000 has been transferred from the general reserve fund, the remainder being charged to revenue. Provision has been made out of revenue to the extent of over £10,000 for new engines and £6,600 for coaching stock.

* * *

PURCHASE of the Scarborough, Bridlington and West Riding Junction Railways by the North Eastern Railway Company, at a cost of £217,281, materially alters the mileage returns of the North Eastern Railway, this length of 27 miles 62 chains being necessarily transferred from the record of lines leased or worked to the heading of "lines owned by the company." An unprecedented item in the directors' report is the reference to the bombardment of Scarborough, Whitby and the Hartlepools by German warships, on December 16th, when five North Eastern Railway servants were killed and 32 others injured, damage also being done to railway property. Over 6,200 of the company's men have joined the colours, including 1,250 who have enrolled themselves on the North Eastern Railway Battalion of the Northumberland Fusiliers, and who are undergoing a course of training at Hull. The Oil Jetty at Salt End, Hull, was opened for traffic during the year. It is anticipated that the electrification of the line between Shildon and Newport will be completed in the summer.

NEW works completed and brought into use on the Great Central Railway include the opening out of Darnall tunnel and widenings between Darnall and Woodhouse, and between Wrawby Junction and Brocklesby; alterations and additions at Brocklesby; and the construction of a new wool shed at the King's Dock, Immingham. Considerable progress has been made with the railway deviation at Keadby; two fixed spans of the new railway and highway bridge over the river Trent are completed, and the opening span is being erected. Widening between Doncaster and Thorne is in progress. A contract has been placed for the widening of the line at Godley and the work is in hand. A substantial portion of the necessary land has been acquired for the extension of the Fish Dock at Grimsby, and tenders were obtained for carrying out the works, but the immediate prosecution thereof has been deferred owing to the war. A group of sidings, being part of the scheme, is under construction. A contract has been let for an extension of the Fish Market to meet the growing business of the fish trade. The new ventilation shaft in Woodhead tunnel has been completed to a depth of about 175 yards, and the chamber connecting the two tunnels therewith is approaching completion. Progress with the construction of the Hull and Barnsley and Great Central Railway between Gowdall and Braithwell has been retarded owing to the war and unfavourable weather. The portion of the Mansfield Railway between Clipstone Junction and Mansfield Town station has been opened for goods and mineral traffic, and fair progress is being made with the remainder of the railway from Mansfield to Kirkby Junction.

* * *

RAILWAY circles generally will hear with regret of the death of Mr. J. Dowling, London and Continental Traffic Superintendent of the Lancashire and Yorkshire Railway. Prior to joining the Lancashire and Yorkshire Railway Mr. Dowling was for 11 years London Superintendent of the Clyde Shipping Co. An Irishman to the core, his geniality, combined with his business ability, gained him a host of friends, by whom he will be missed.

* * *

MR. HUBERT T. BAILEY, of the firm o Stephenson, Clarke & Co., has been elected a Director of the Great Eastern Railway Company in place of the late Mr. J. F. S. Gooday. Besides being a member of the firm of Stephenson, Clarke & Co., Mr. H. T. Bailey is a Director of the Askern Coal and Iron, Bedwas Navigation Colliery, and Billingsley Colliery Companies.

* * *

THE King has been pleased to direct that the Earl of Bessborough, C.B., C.V.O., Chairman of the London, Brighton and South Coast Railway, be appointed a Knight of the Order of St. Patrick. The vacancy was caused by the death of Lord Roberts.

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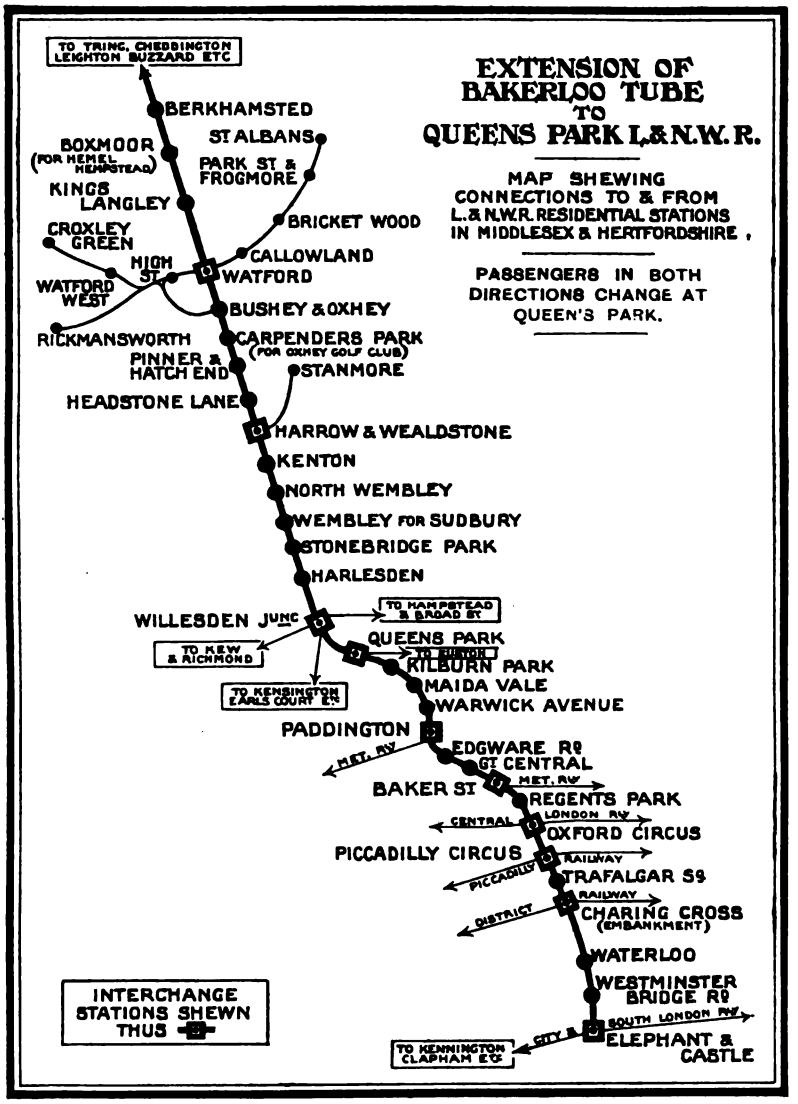
Sir William J. Goulding, Bart., D.L., has been unanimously re-elected Chairman of the Irish Clearing House Committee for year 1915.

* * *

The extension of the "Bakerloo" section of the London Electric Railway from Paddington to Queen's Park has already been described, and on another page further reference is made thereto and to the opening as far as Kilburn Park on January 31st. The final stage was brought into public use on Thursday, February 11th, thus linking up the whole of the London "tube" railway system with the London and North Western suburban area, and providing for convenient journeys, with only a single change at Queen's Park (pending the inauguration of through running), between all parts of London and Watford Junction, Watford (High Street), Bushey and Oxhey, Carpenders Park (for Oxhey Golf Club), Pinner and Hatch End, Headstone Lane, Harrow and Wealdstone, Kenton, North Wembley, Wembley for Sudbury, Stonebridge Park, Harlesden, Willesden (new station). Through fares are in operation and cheap season ticket rates are offered. The map reproduced on this page indicates the special value of this new inter-communication link.



A NEW LINK IN LONDON INTER-COMMUNICATION AND ITS TRAFFIC VALUE.

* * *

Owing to the war little business has been dealt with at the Hull Joint Dock, which was opened for traffic on August 1st last. The Salt End Jetty has been completed and brought into use.

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Construction of the Joint Railway of the Hull and Barnsley and Great Central Companies, from Gowdall to Braithwell, has not made the progress that had been expected. Delays in delivery of materials through labour troubles and shortage of labour owing to the war have hampered the contractors, but it is now anticipated that the line will be ready for traffic about the middle of the year.

* * *

ROLLING stock owned by the London Electric Railway Company has a carrying capacity of 23,464 seats, made up as follows:—180 motor cars, 7,472 seats; 138 control trailer cars, 7,168 seats; and 170 trailer cars, 8,824 seats. As a result of the war a new item of expenditure appears in this company's account for 1914, namely, £889 10s. 7d. for watching, patrolling, etc.

* * *

HEAVY capital expenditure is estimated by the directors of the Central London Railway for the current year. Extension of car sheds at Wood Lane and miscellaneous new works and additions will require £10,000. The Ealing Extension is expected to absorb £71,000, while the figure set down for rolling stock is £58,700. During the year ending December 31st last, watching and patrolling the company's lines and premises cost £254 7s. 1d.

* * *

AWKWARD and heavy loads are everyday features in goods traffic working on the Lancashire and Yorkshire Railway, and exceptional skill and knowledge is required on the part of the officials concerned in the safe transport of loads of exceptional dimensions and weight. The company possesses 39 special wagons for traffic of this character, and in addition 112 open and 50 covered wagons for loads of over 20 tons.

* * *

DURING the year ended December 31st, 1914, the capital expenditure of the Hull and Barnsley Railway included £61,700 for rolling stock, made up as follows:—Five 0-6-2 tank locomotives, £13,700; 650 open wagons, 8 and up to 12 tons, £43,875; and 15 brake vans, £4,125. The estimate of further expenditure on capital account for rolling stock during the year 1915 is £18,300.

* * *

DETAILS of capital expenditure by the Great Eastern Railway for the year 1914 show that two new dining saloons cost £2,612, and two third-class vehicles with dining compartments, £2,020. Thirty ballast wagons cost £2,370, and two ballast brakes £292, while a pair of motor boats absorbed £2,313 2s. 9d.

* * *

DURING the year 1915 the Great Southern and Western Railway has arranged to expend capital to the extent of £15,000 for 135 new covered goods wagons and £5,800 on 65 open goods trucks. The conversion of a wagon shop at Inchicore into a running shed is to cost £900. Estimated capital expenditure at Inchicore likewise includes a new paint shop, £1,800; extension of foundry, £400; and new machinery, £400.

CAPITAL expenditure by the Great Northern Railway of Ireland during 1914 included the large sum of £25,006 1s. 7d. on account of rolling stock. Five tank engines (4-4-2 class) cost £16,453; three converted carriages, £1,500; additional gangways on carriages, £360; fifty 10-ton covered goods wagons, £5,710 7s. 3d.; eight 10-ton open goods wagons, £755 2s. 3d.; and one glass wagon, £227 12s. 1d. During the current year the estimate of further expenditure on capital account for rolling stock amounts to £3,000 for carriages and £31,000 for wagons.

* * *

IMPORT and export trade at the Bute Docks, Cardiff Railway, for the year 1914 amounted to 13,054,419 tons, being a decrease of 622,522 tons compared with the previous year. The general disruption caused by the war has rendered it extremely difficult to carry on the work of the docks, and there has been a substantial increase in the expenditure. Bearing in mind the unprecedented circumstances attending the working of the docks and lines from August onwards the result reflects considerable credit on all concerned, and bespeaks able management on the part of Mr. C. S. Denniss, General Manager.

* * *

MR. J. E. ABBOTT and Mr. A. Lamb have been appointed assistants to Mr. C. J. Selway, Superintendent of the Line, Great Northern Railway. Mr. Abbott's duties lie in the control of the working of the passenger, goods and mineral traffic; and those of Mr. Lamb in matters of staff, special traffics, rules and regulations, and the general commercial business of the department.

* * *

AT the February Meeting of the Railway Club, Mr. H. L. Hopwood gave an interesting account of the smaller railways and "systems" of Wales, especially referring to the narrow gauge lines. The unusual methods of operating the "slate conveying" lines was described at some length, and a large amount of descriptive matter relative to the history, engineering and locomotive features of the railways under review was submitted to the meeting. The paper was illustrated by maps and photographs, and was accorded a hearty reception. On March 9th, Mr. Cecil J. Allen will read a paper on "Anglo-Scottish Train Services," while on March 25th, Mr. W. J. Thorrowgood (L. & S.W.R.), will deal with "The Art of Railway Signalling."

* * *

WE regret to record the death of Mr. Henry Cecil Newton, Secretary and Accountant, Midland Railway (London, Tilbury and Southend section). He had been unwell for some little time past, but death was unexpected, and came as a great shock to his staff, by whom he was greatly respected and esteemed.

* * *

SIR ROBERT TURNBULL, M.V.O., late General Manager, London and North Western Railway, has been appointed a director of the London, Brighton and South Coast Railway Company in place of Mr. J. F. S. Gooday, deceased.

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Photo] [*F. E. Mackay.*

Glasgow to Euston via the West Coast Route.

10 a.m. Glasgow-Euston Restaurant Car Express on the Caledonian Railway.

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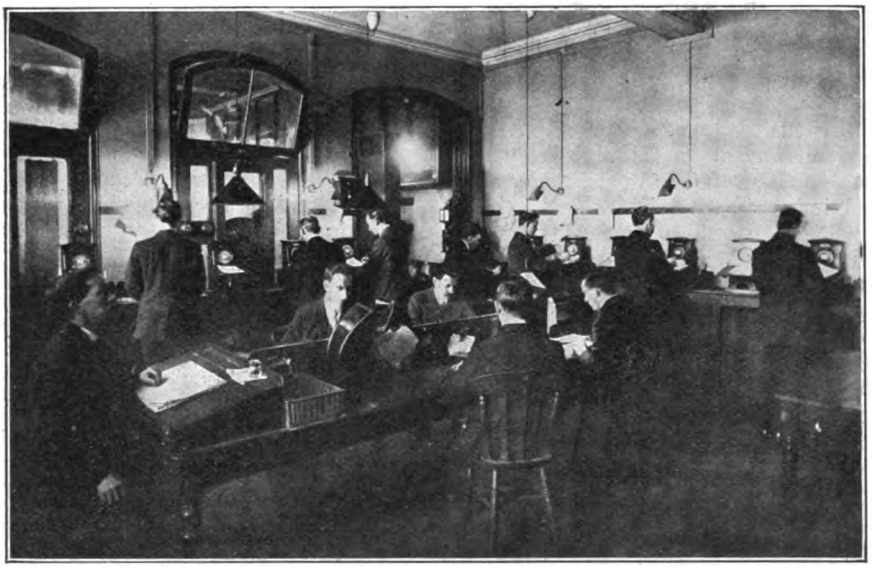

TELEGRAPH OFFICE: LONDON BRIDGE STATION.

Electricity in the Service of a Great Railway.

THE ELECTRICAL DEPARTMENT OF THE LONDON, BRIGHTON AND SOUTH COAST RAILWAY.

By J. F. GAIRNS.

IN many ways the London, Brighton and South Coast Railway possesses special interest to the electrical engineer. In respect of electric traction we have on this line what is still the most remarkable installation of its class in the United Kingdom, while the fact that considerable extensions of the "elevated electric" system of lines are in progress raises the electric traction scheme of this company beyond the usual suburban electrification proposals. Indeed, taking into account what has already been done and works in progress or immediate contemplation, there is the nucleus of a comprehensive programme, and it was mainly the fact that in due course some of the main lines will also be involved, that influenced the selection of the high-tension single-phase system in preference to the usual direct-current methods of working traffic electrically.

Therefore, besides being unique in that the single-phase high-tension system of electrical working is adopted on a considerable scale, the extent of equipment in contemplation and other possibilities give special interest to electrical traction on the "Brighton" line, while the apparatus employed and other features render this aspect one of special interest.

But the work of the electrical department of the London, Brighton and South Coast Railway goes much further than this. Mr. R. H. Houghton, who was appointed Telegraph Engineer and Chief Electrical Engineer to the Company in 1909, is also responsible for (1) the postal and public telegraph work dealt with under railway auspices—incidentally, it is believed, the London, Brighton and South Coast Railway deals with more post office telegrams than any other Company in the United Kingdom—(2) private and signalling telegraphs and telephones; (3) instruments used for train signalling; (4) upwards of 200 signals worked electrically; (5) electric train lighting, an important factor on this line; (6) electric light and power all over the system; (7) electric cranes,

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lifts, capstans, traversers, etc., used at goods and passenger stations, depôts, warehouses, wharves, etc.; and other miscellaneous work. In the aggregate, therefore, the electrical department on this line is by no means a secondary one, and it is, moreover, organised independently, instead of being, as it is on many other lines, a sub-department under the chief civil or mechanical engineer.

Mr. Houghton has under his direction and attached to his department nearly 700 men, including the motormen engaged on electric trains, and about 90 telegraph clerks, together with men employed at the Peckham Rye electric repair shops, at the Selhurst carsheds, and at the telegraph and electric light workshops at New Cross, Battersea, Horsham and Brighton, besides linemen and other assistants engaged in general electrical inspection, maintenance and repair duties.

MR. R. H. HOUGHTON, B.SC., M.I.C.E., M.I.E.E.
Electrical Engineer,
London, Brighton and South Coast Railway.

Before dealing with these aspects, it will be convenient to devote attention first to the electric traction side of our subject, though this has so often been referred to that it does not call for extended description.

In this connection it is necessary to associate the name of Mr. Philip Dawson, M.Inst.C.E., Consulting Electrical Engineer to the Company. It was largely on his advice that in order to deal with the special conditions prevailing on this line, the high-tension single-phase system was adopted, and he is responsible for the design and equipment for electric traction.

He has been much criticised for so strongly advocating a radical departure from usual methods of electric traction, though even when he first became concerned there was a fair amount of experience abroad to go upon, and the years which have since elapsed have shown a considerable adoption of similar methods for far harder conditions in America and certain European countries.

In a paper read in 1911 before the members of the Institution of Civil Engineers, Mr. Dawson set forth the principal factors which had induced him to advise the London, Brighton and South Coast Railway to do as they have done. As he then showed, the matter had been under consideration since 1903, the intention even at that early date being to commence with the South London line between Victoria and London Bridge. This, by the way, brings us back to a period when the tramway competition with South London line traffic was only beginning to show itself, as will be seen

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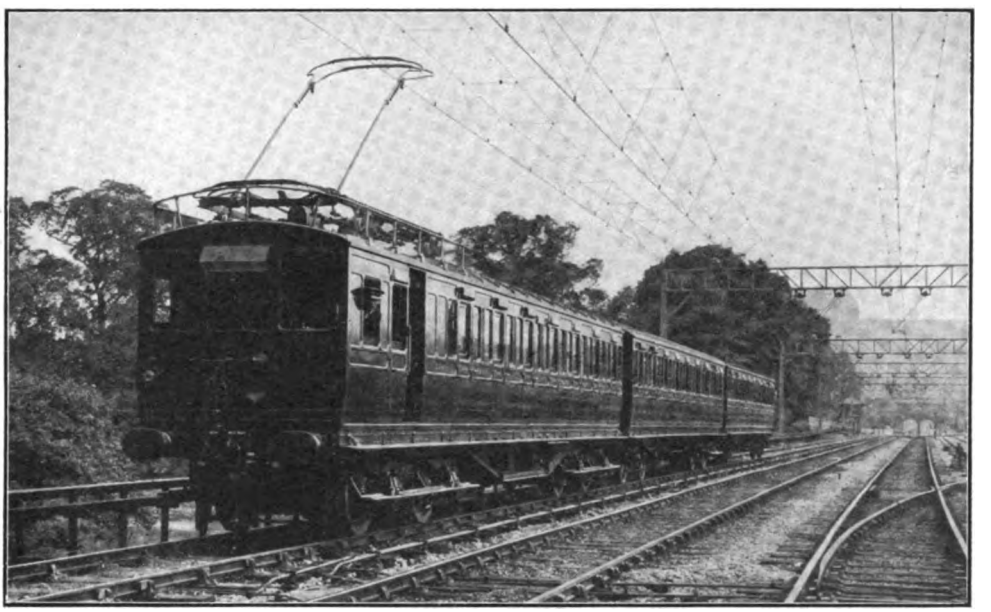
by the following statistics of annual passengers booked at Peckham Rye station :—

1902. Before the opening of the L.C.C. tramways—1,213,281.
1909. Last year of steam trains—526,373.
1910. First year of electric trains—1,051,263.

Preparatory work for the equipment of the South London line was commenced in 1906, and on January 17th, 1909, the first experimental train was run between Battersea Park and East Brixton, though it was not until December 1st in that year that "Elevated Electric" traffic publicly commenced. As Mr. Dawson points out, the problem was not entirely one of working ordinary suburban traffic. If it had been, it is quite probable that usual methods would have been adopted. Instead, it was realised that eventually suburban trains would be operated electrically at least as far as Coulsdon, nearly one-third of the way to Brighton, and on a route with which the Eastbourne, Newhaven, Hastings, and Worthing lines, besides a number of other inter-connecting branch lines, can all be associated by means of relatively short extensions of equipment, should it be decided to electrify through to Brighton. There was also the further suggestion that while the Horsham-Portsmouth route might not itself justify equipment, it would be a relatively simple proposition to deal with Portsmouth traffic *viâ* Brighton, adding, it is true, about ten miles in distance from London, but *viâ* the busy and important Brighton-Portsmouth coast-line, and utilizing the equipment of the chief main line from London to Brighton.

It will, therefore, be understood that ultimate electrification for main-line traffic, was from the first considered to be entirely a "practicable" proposition, though even yet there is probably a long way to go before it will be realised. However, this view afforded entire justification for "looking ahead" and for taking into account objections to conductor rails along the track, and that main line electrification involves conditions which do not apply on purely intense-traffic suburban lines.



THREE-COACH TRAIN, NEAR GIPSY HILL STATION.

There is no need to go further into this aspect, for much of it is now an "oft-told tale"; but already it is apparent that while single-phase high-tension electrification with overhead conductors involves special equipment of trains and of distributing arrangements, the system does not involve any complications on the running lines. Platelaying, signalling and general engineering work is not, therefore, affected; no alterations to track, points, crossings, station platforms, etc., have been entailed, and except for the overhead conductors and their supports, there is no radical difference between the electric traction lines and those

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where steam haulage is universal. There were also certain electrical considerations, and a clause in the 1903 Act, under which electrification powers were granted, which influenced the matter.

Following the initial South London section, the Clapham Junction-Crystal Palace route, with the Norwood Junction and Selhurst extensions to give access to the Selhurst car-sheds and depôt, was added as an electrically worked route on May 12th, 1911, and the Peckham Rye-Tulse Hill section, with the connecting spurs to West Norwood and Streatham Hill, on June 1st, 1912. This gives a system of electric lines covering 70 miles of single track and affecting 22 stations (if Norwood Junction is included, though only a few trains working into or out of traffic are dealt with there electrically), all regular traffic by trains restricted to these routes having been operated electrically since the dates of inauguration. Between Balham and Victoria both main and local lines are equipped with conductors, so that trains can be run on the fast lines if required, as to meet the needs of fast working or in the event of a break-down affecting the local tracks.

MR. PHILIP DAWSON.
From a painting by Mr. Stanhope Forbes, exhibited last year at the Royal Academy.

Work is also in hand for extensive additions, involving the Balham-Selhurst, Tulse Hill-Sutton, Selhurst-Sutton, Norwood Junction-East Croydon, and New Cross-Norwood

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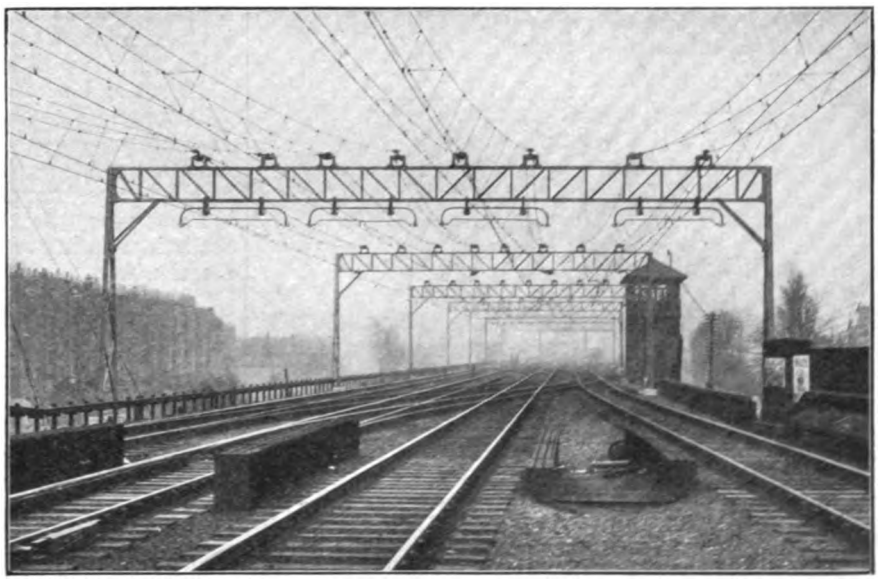
Junction sections, with their connecting loops and junctions ; and over a considerable mileage the supports for the overhead conductors are in place. Unfortunately, however, the war and other factors have caused unavoidable delay in proceeding therewith, but before very long the electrical working of the Victoria and London Bridge-Sutton and East Croydon lines by various routes may be expected, a total of no less than 178 miles of single track.

The incurring of heavy capital expense by the erection of a power station, even if it can be used for many purposes besides that of traction, does not find favour on the Brighton line, and therefore traction current is purchased from the London Electric Supply Corporation, with a metering cabin at Queen's Road, distributing stations at Peckham Rye and Tulse Hill, and switch cabins as required. Single-phase alternating current of 6,600 volts and 25 periods is used, supplied without transformation to the overhead conductors. These are carried on supports of various patterns, according to the circumstances of each location and the number of conductors to be suspended therefrom by catenaries. Several examples are shown in respective illustrations.

Single concentric cables, either underground or carried by supports alongside the line, connect the distribution and switch cabins. Current is collected from the overhead conductors by " bows " on the trains, and current passes therefrom to the high-tension side of step-down transformers on the trains, the low-tension side feeding the motors. The conductors are sectionalised from station to station and for each track, except at cross-overs, where a degree of complication is is necessarily involved. The overhead structures generally consist of steel lattice girders mounted on steel towers, many being designed on the cantilever principle. The whole of the electrical equipment of the lines has been carried out by Messrs. R. W. Blackwell & Co., Ltd.

For the South London line the original three-coach trains of specially built stock, 9 ft. wide, are still retained, but are now used in two coach units, two of which are coupled at busy periods. On other routes the unit is three coaches, a middle motor coach, and two control trailer coaches, there being thus drivers' control compartments at each end. At busy periods two three-coach units are coupled and operated by multiple-unit control. For these services the vehicles are of usual types, as the Crystal Palace tunnel restricts the width to 8 ft. A few nine-coach or three-unit trains are operated during periods of special traffic pressure.

Many of the trailers have been built or altered from steam stock at Lancing carriage works, under the direction of Mr. A. H. Panter, Carriage Superintendent. Vehicle



BALHAM JUNCTION, SHOWING SECTION INSULATORS.

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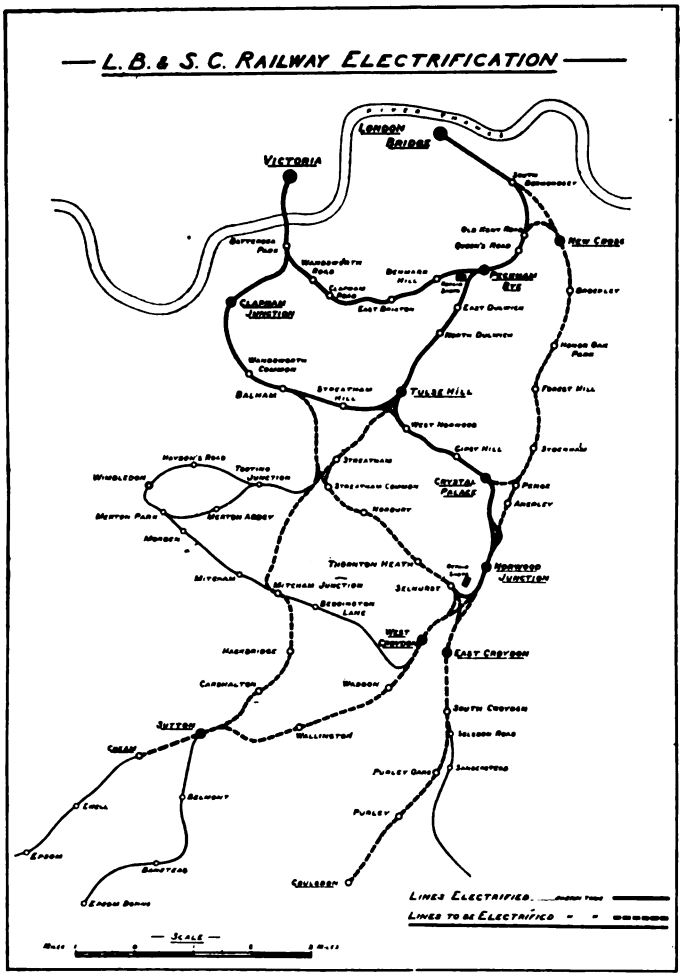

MAP SHOWING LINES ELECTRICALLY EQUIPPED AND THOSE IN PROCESS OF ELECTRIFICATION.

bodies are of wood, with steel underframes, but to obviate the effects of possible electrical leakage, roofs and sides are covered with sheet aluminium, and the flooring is double, with slag wool packing, the undersides being covered with Uralite sheeting and sheet aluminium.

Each South London motor coach has four 115 horse-power motors, the others having four 150 horse-power motors. Working in conjunction with each pair of motors is a 220-kilowatt main transformer, reducing from 6,600 volts to 750 volts on the secondary side. Contactors enable current to be supplied to the motors at 450, 580, 640 or 750 volts. Power for the control circuits is obtained from an auxiliary transformer, which supplies a secondary voltage of 300, for control, operating the brake compressors, and for lighting purposes. Special arrangements are made for protecting the high-tension apparatus.

At present the electric rolling stock consists of 50 motor and third-class coaches, giving seating capacity for 3,436 passengers, and 94 composite trailers for use therewith, these providing 2,240 seats in first-class compartments and 4,720 third class. Two petrol rail-motor cars are utilized by the electrical department, one for special inspection work and the other, fitted with a rising platform and necessary appliances and accessories, for general repair and maintenance of the overhead conductors and supports.

Last year the mileage statistics relating to electric traction were :

	Miles.
Passenger traffic,	1,409,622
Shunting and empty,	9,644
Total ..	1,419,266

This is an increase of 6,456 miles in productive mileage, though the full increase was only of 3,862 miles, owing to the considerably larger unremunerative mileage which occurred in 1913. Both at Victoria and London Bridge five platforms are equipped with conductors. Out of London Bridge, however, only the three South London lines are equipped, the middle line being, by the way, signalled for alternative up or down running, according to the pressure of traffic, and this applies to the electric trains as well as those hauled by steam locomotives.

There are two electric repair shops, one at Peckham Rye and the other at Norwood, attached to the Selhurst car-sheds. Peckham Rye deals with most of the overhauling and more important repair work, the shops at Norwood being concerned mainly with minor work associated with the usual daily and weekly inspections of rolling stock. At Peckham Rye there is a carriage shed, and

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the shops are well equipped with machine tools as required, armature winding appliances, etc., while at both shops Stothert & Pitt electric cranes and capstans provide for lifting and moving vehicles respectively.

It is now necessary to deal with other phases of electrical work, and train lighting may be first considered.

The London, Brighton and South Coast Railway was the first to light complete trains electrically, the Stroudley & Houghton system of axle-driven dynamos in the brake vans of set trains being adopted as far back as 1881. This system was devised by Mr. E. J. Houghton, father of the present Chief Electrical Engineer, in conjunction with the late Mr. William Stroudley, Locomotive Superintendent, and it is interesting that it is still used for the "Brighton" Company's Royal Train, and there are even now 85 vehicles fitted in accordance therewith, though for the sake of uniformity these are being gradually replaced by Stone equipments, of which there are 790 in service. As a rule vehicles are now equipped in complete units, but there are a number of pairs of vehicles supplied from one generating set.

Electric lighting and power for general use aggregates 393 arc lamps, 12,358 glow lamps (exclusive of train lighting), and an approximate horse-power for electric motors for machinery of 5,706. These apply largely to goods depôts and yards, and the following details of equipment will be of interest.

At Deptford Wharf the power station includes two Babcock & Wilcox boilers supplying two Browett Lindley 200 horse-power two-crank compound engines direct-coupled to two 125 kw. (480 amps., 260 volts) compound wound Dick-Kerr dynamos. There is also a Highfield reversible booster, a "Chloride" battery of 112 cells of 27 plates each (capacity 300 amps. for 1 hour or 750 amps. for short periods), and an 8-panel Dick-Kerr switchboard.

The working plant includes one 3-ton electric derricking crane (Stothert & Pitt) serving a radius of 35 ft., and fitted with two 40 horse-power and one 8 horse-power motors. This is generally used with 30 cwt. grabs for unloading coal and other minerals, in conjunction with the hydraulic cranes. There are also eleven 20-cwt. electric travellers, also supplied by Messrs. Stothert & Pitt, and each fitted with three motors of 16, 6 and 3 horse-power respectively. These are used for unloading grain and other produce from lighters and barges into railway wagons or for warehousing. A 15 horse-power electric capstan is also available and this provides for a pull of 1 ton at 50 ft. per minute. Here the wharf, warehouses and offices are entirely lighted by electricity, with portable arrangements at the dock sides for lighting ships while unloading at night.

At Willow Walk there are 125 arc lamps in the yards and sheds, and 280 incandescent lamps in the offices, but all cranes, lifts, and capstans are hydraulic. The electric power plant is, therefore, only a small one, there being six Crossley gas engines

THREE-TON CRANE: DEPTFORD WHARF.

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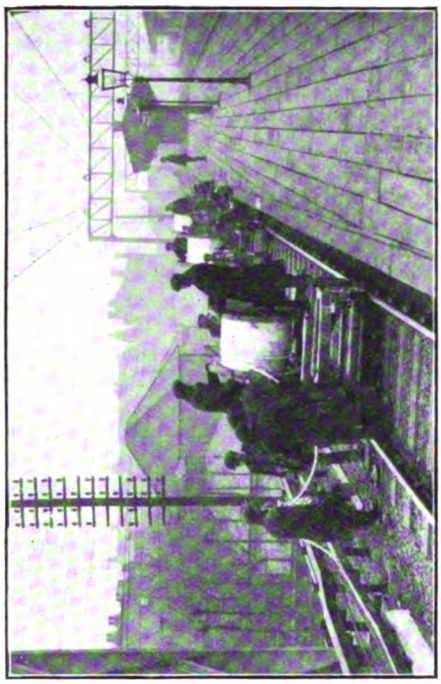
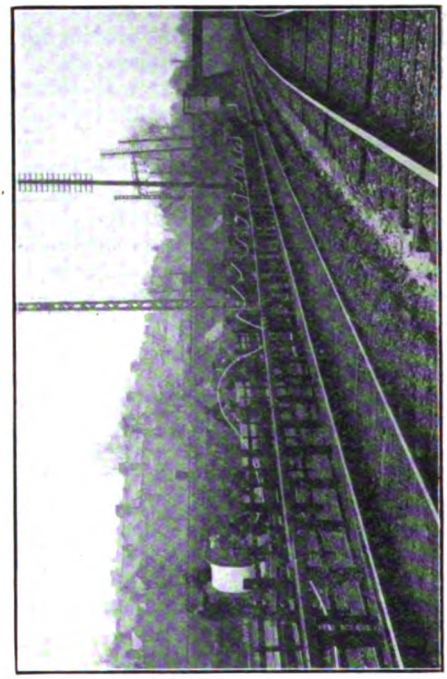
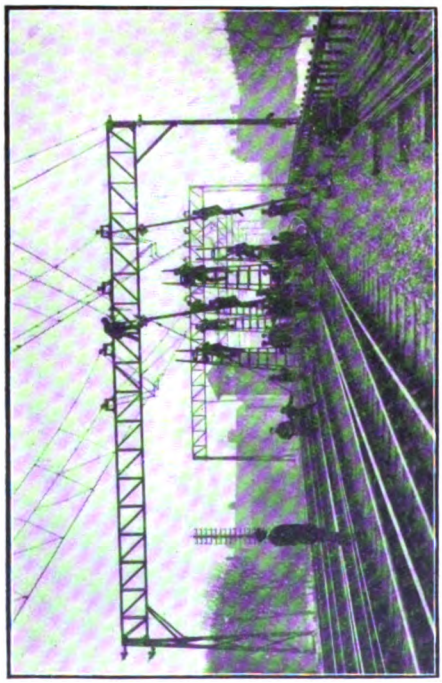


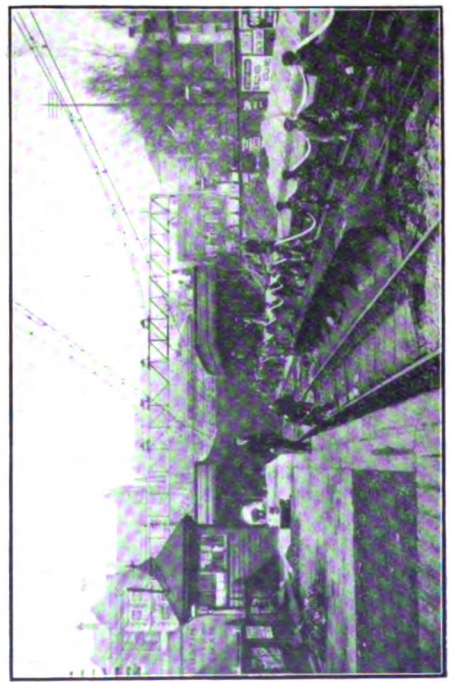
LAYING CABLES, BALHAM.



LAYING CABLES, TULSE HILL.



ERECTING OVERHEAD CONDUCTORS, BALHAM JUNCTION.



LAYING CABLES AT WEST NORWOOD.

"Equipping the Lines for Electric Traction."

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(total b.h.p. 220), driving respectively three Thomson-Houston 2,000 volt, one Siemens 3,000 volt and two compound wound G.E.C. 230 volt dynamos; and even this plant is to be displaced, arrangements being in progress for taking a bulk supply of current from the London Electric Supply Corporation.

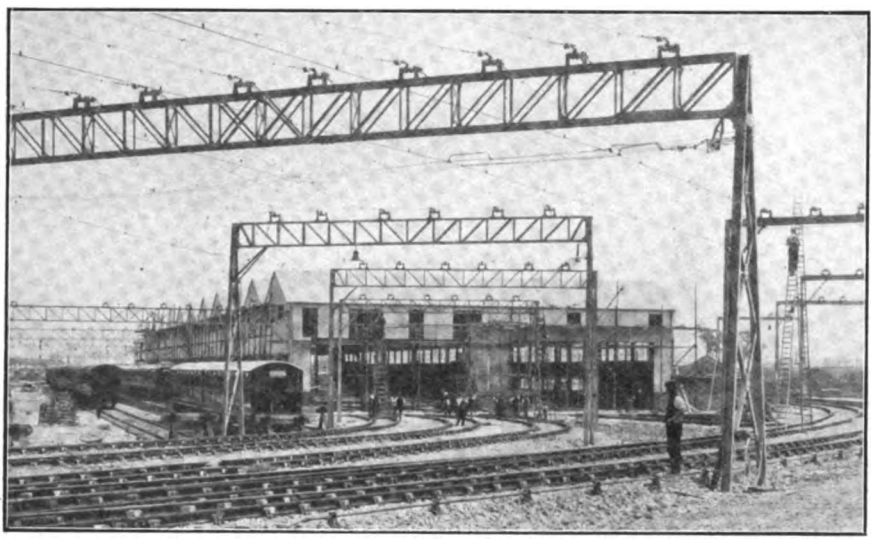
At Newhaven Harbour electricity is mainly used for lighting. The generating station is supplied with steam from the boilers in the hydraulic station. There are four Willans high-speed engines driving four brush arc light dynamos (10 amps., 2,500 volts), and 2–10 kw. compound 230 volt E.C.C. dynamos. These supply 118 arc lamps for lighting quays, yards and warehouses, and 178 metal filament lamps for office lighting, etc. Current is also supplied for lighting and charging batteries at the more distant premises of the Company.

At this stage we may mention that the passenger steamships *Paris*, *Dieppe*, *Brighton* and *Arundel* are all lighted by electricity, also several of the Continental cargo ships, and altogether these involve about 1,100 60-watt lamps, besides electric fans for ventilating purposes. These are only half of the joint fleet, the other boats being maintained by the French State Railway.

At London Bridge electric lighting of the offices and part of the circulating area, with electric signs, entails an equivalent of 1,876 20-watt lamps. There are also several small motors for air and gas compressing, heat circulating, fans, etc. Current is obtained from the London Electric Supply Corporation.

Only part of Victoria station is electrically lighted, there being 13 arc lamps and 368 30-watt metal filament lamps. In addition there are 16 Easton's electric lifts, each fitted with 9 horse-power motors and adapted to carry 30 cwt. at 50 ft. per minute. Motors are also used for operating sewage and drainage pumps.

At Clapham Junction there are three electric lifts by Childs, of Willesden, each fitted with a 6 horse-power motor on push button control, with safety bar device. These are each capable of carrying 15 cwt. at 60 ft. per minute. The new part of the station is electrically lighted by 10 arc lamps and 68 30-watt metal filament lamps.



ELECTRIC REPAIR SHOPS AND CAR SHEDS, SELHURST.

At Sutton a lift by Howard Martineau, fitted with a 7.5 horse-power single-phase alternating-current motor, by Bergtheil & Young, on push button control, is provided to facilitate dealing with milk traffic. This has a capacity of 20 cwt. at 60 ft. per minute. The lift and stages are electrically lighted.

The platforms at Brighton are lighted by high-pressure gas, but the offices and other premises are lighted by electricity, 689 30-watt metal filament lamps being used for this purpose. One electric lift by Etchells,

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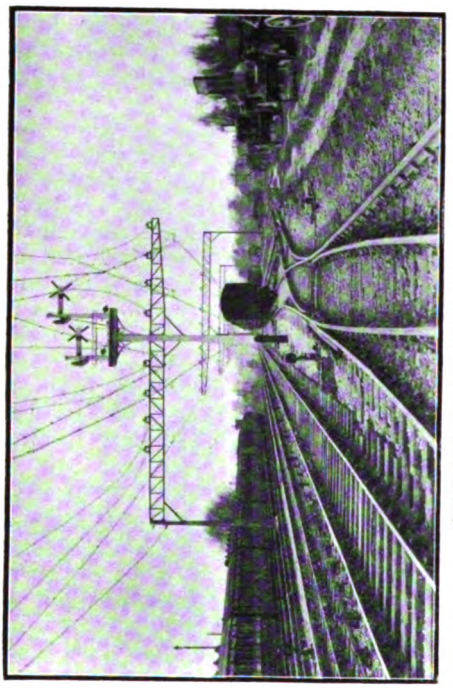
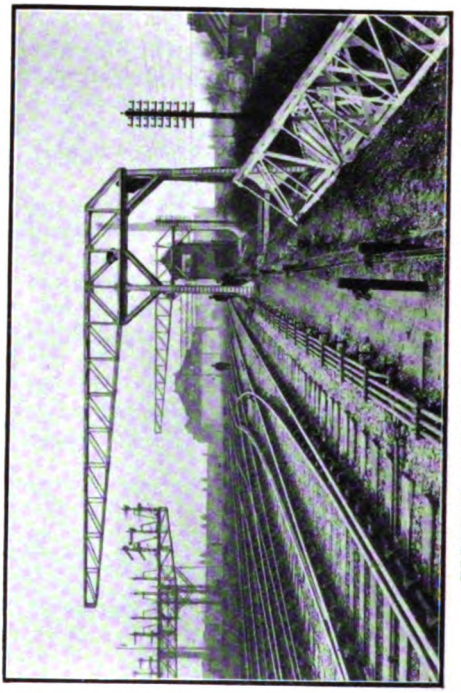
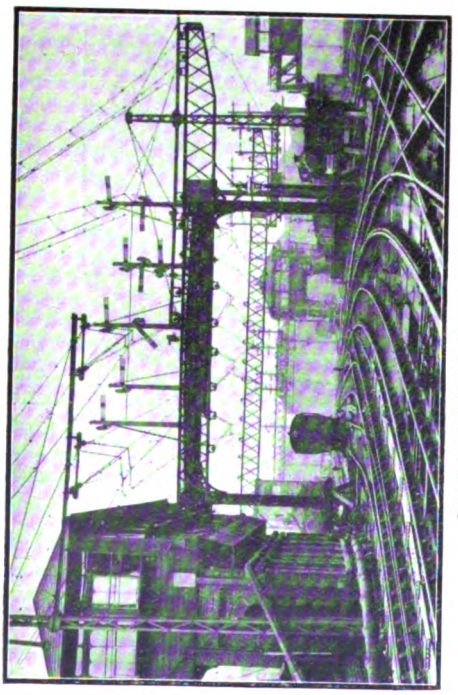


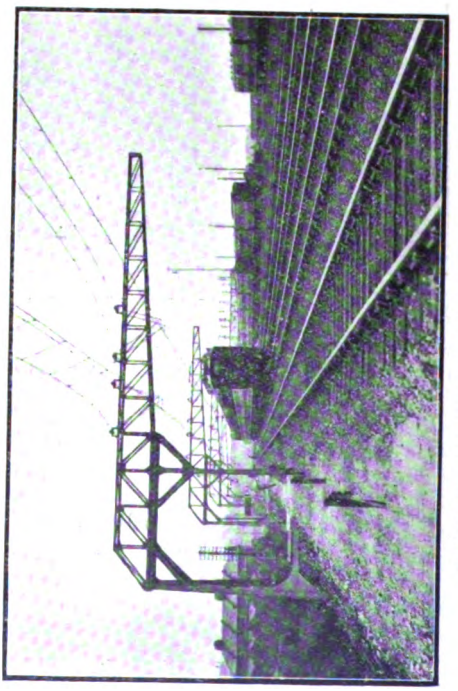
CANTILEVERS AT STREATHAM HILL.



ERECTING CANTILEVERS, POUPARTS JUNCTION.



OUTSIDE LONDON BRIDGE STATION.



CANTILEVER SUPPORTS, POUPARTS JUNCTION.

Cantilever and other Supports for the Overhead Conductors.

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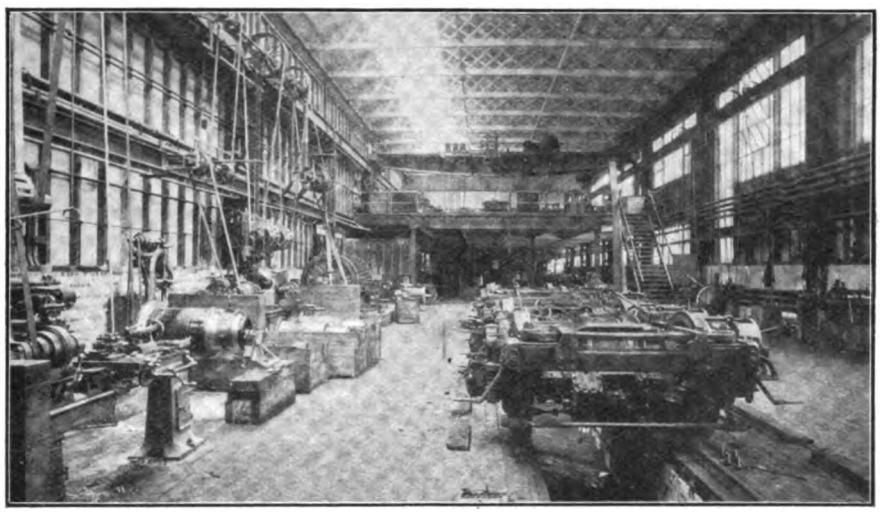
Congdon & Muir has been installed in the parcels office. This is fitted with a 10 horse-power Rhodes motor and has a capacity of 20 cwt. at a speed of 80 ft. per minute.

At Hove two electric lifts by Waygood are installed for dealing with passengers' luggage, milk and general merchandise, each fitted with 5 horse-power motors having a capacity of 15 cwts. at 60 ft. per minute. Current is obtained from Hove supply mains. Two electric lifts, by Stannah, are installed at Worthing for passengers' luggage, fruit, etc., each fitted with 7·5 horse-power motors with push button control and a carrying capacity of 20 cwt. at 70 ft. per minute. Current is obtained from the Worthing Corporation.

A number of arc lamps and illuminated signs have been fitted for the purpose of advertising the electrified sections of the line; 742 30-watt lamps and 16 Metroflam arc lamps being installed for this purpose.

Cold Blow Signal Works (New Cross) have been recently converted from steam driving, and the work greatly facilitated, 4 large motors having been installed (about 120 horse-power total). Current is obtained from outside source.

The whole of the machine tools and compressors, etc., used in the New Cross Locomotive and Carriage Works are driven by electric motors, having a total of 135 horse-power. Electric lighting is gradually taking the place of gas, 567 metal filament lamps having been installed. The machines in the New Cross Telegraph Shops are driven by electric motors.



REPAIR SHOPS, PECKHAM RYE.

In conjunction with the London and South Western Railway two 30-cwt. electric jib cranes have been installed on the pier at Portsmouth Harbour to deal with the Isle of Wight luggage and parcels traffic. Each crane is of special design to suit the different levels of the station; made by Messrs. Stothert & Pitt, fitted with one 30 horse-power and one 5 horse-power Bergtheil & Young motors for lifting and slewing respectively, lifting speed 200 ft. per minute. In conjunction with the London and South Western Railway two electric pumps have been installed for dealing with the water in Ryde tunnel, Isle of Wight. Each pump has a 8 horse-power motor with automatic control actuated by the water level.

The repair of Grosvenor Bridge is being greatly facilitated by electricity in the form of six portable electric drills; one 15 horse-power motor driving air compressor, a 1 horse-power electric blower in Smiths' Shop, and 29 electric lamps.

Electric motors are used for driving the machines in the Battersea Park Telegraph Shops, and the shops are lighted by 32 metal filament lamps. Two storage batteries ("Chloride") are provided for supplying current to the electric signalling in the district, current being taken from the Battersea Borough Electricity supply.

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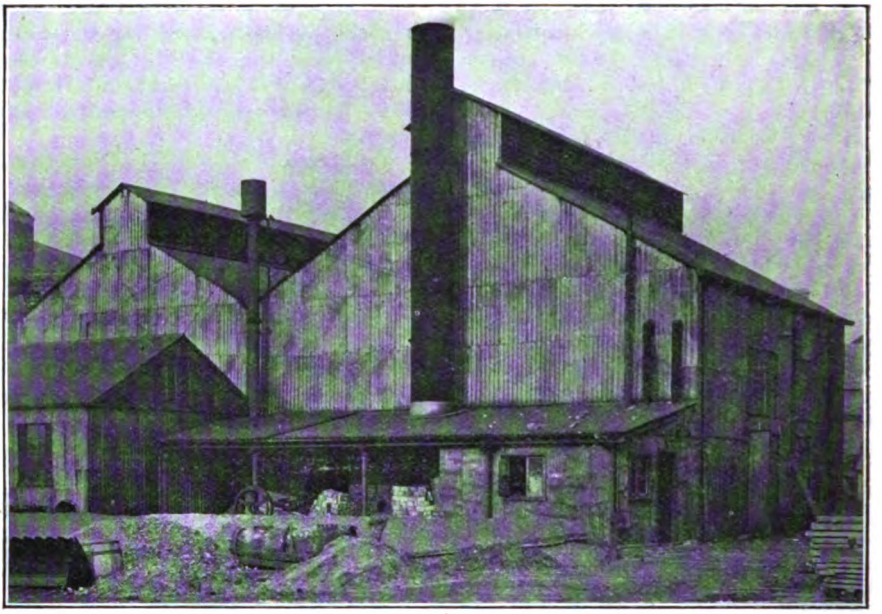
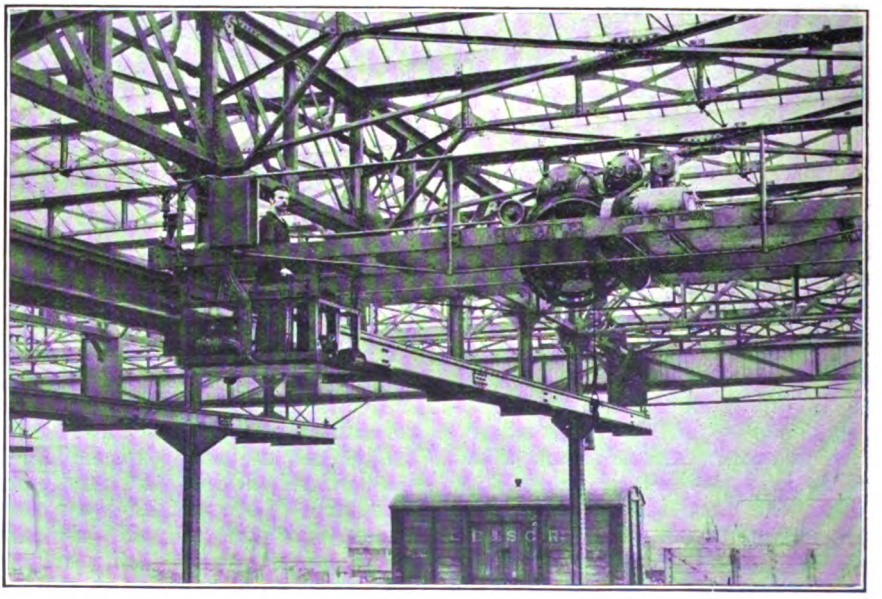


POWER HOUSE: DEPTFORD WHARF.

Norwood Junction Telegraph Shops and Clock Department are lighted by electricity, having 55 30-watt lamps and driven by electric motors. Current is obtained from Croydon Corporation. Norwood Junction Sidings are illuminated by 24 Metroflam arc lamps.

In several of the above cases the electric lighting has been modified during the war.

The East Croydon Engineers' Works are driven by electric motors having an aggregate horse-power of 252 and lighted by 12 flame arc lamps and 124 30-watt metal filament lamps. The Staff Athletic Club



ELECTRIC TRAVERSER: DEPTFORD WHARF.

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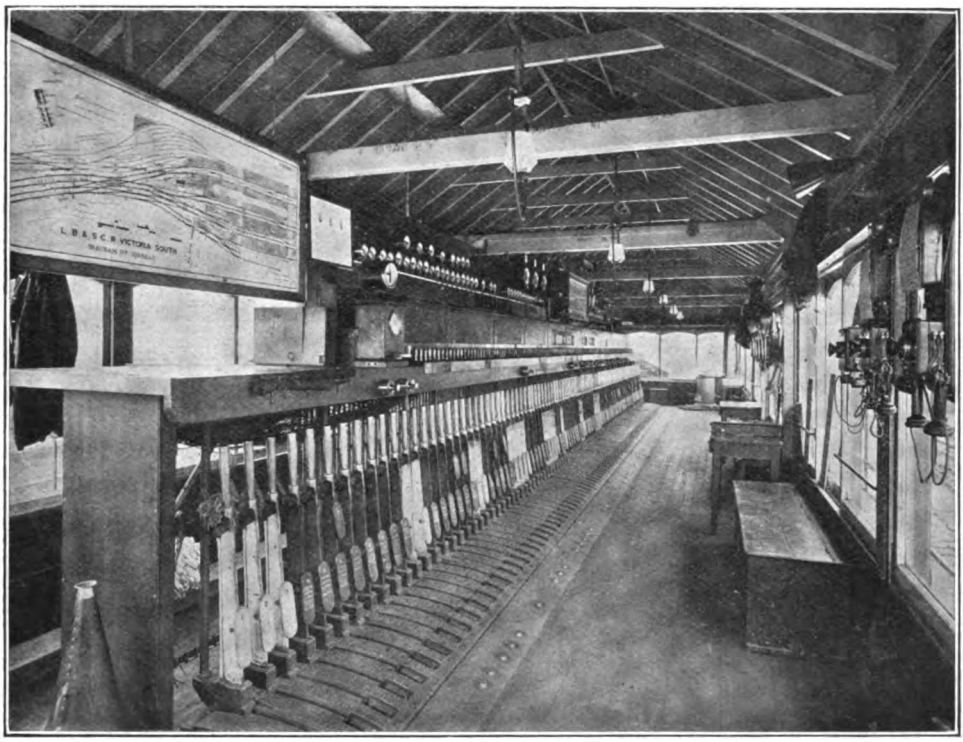
and Rifle Range adjoining these works are lighted by 89 30-watt metal filament lamps.

At Brighton the Locomotive and Carriage Works have been completely converted to electric driving and are fitted with motors of various makes and types to an aggregate of 1,458 horse-power and electric cranes and lifts of 771 horse-power. Electric lighting is gradually replacing gas, while electric welding, heating, etc., account for a fair consumption. The whole of the current required is obtained from the Brighton Corporation. A description of these works appeared in the RAILWAY MAGAZINE for June, 1913.

In the Engineers' Shops the wood working whole of the works are driven by electric motors having an aggregate of 697 horse-power, while the cranes are fitted with motors of 213 horse-power. The greater portion of the works is lighted by high-pressure gas, but this has been displaced by electricity in several sections and the whole of the offices, stores and mess rooms are lighted electrically by about 7 arc lamps, 1,419 metal filament 30-watt lamps, and 880 carbon lamps. The electric kitchen for dealing with meals for the workmen is fitted with some of the largest electric cooking utensils in this country, and would require a special article to describe them.



SOUTH SIGNAL BOX: VICTORIA STATION.

and smiths' shop are electrically driven by four motors, total 41 horse-power. Current is obtained from Brighton Corporation. In the Stores Department there are 2 electric jib cranes, having motors of 13.5 horse-power, and electric lighting is contemplated.

The Generating Station at Lancing Carriage Works, includes the following plant: One 375 brake-horse-power and one 250 brake-horse-power Deisel engines, but two engines of smaller horse-power are now being installed to replace the former. The

Foregoing remarks show that there is a considerable amount of general electrical work on the London, Brighton and South Coast Railway, but as compared with other lines where electric lighting is used on a wide basis, and where electric power for all purposes is general, the record is not an exceptional one. In respect of telegraphic and other installations, however, the London, Brighton and South Coast Railway occupies a special position.

For ordinary signalling there are 106

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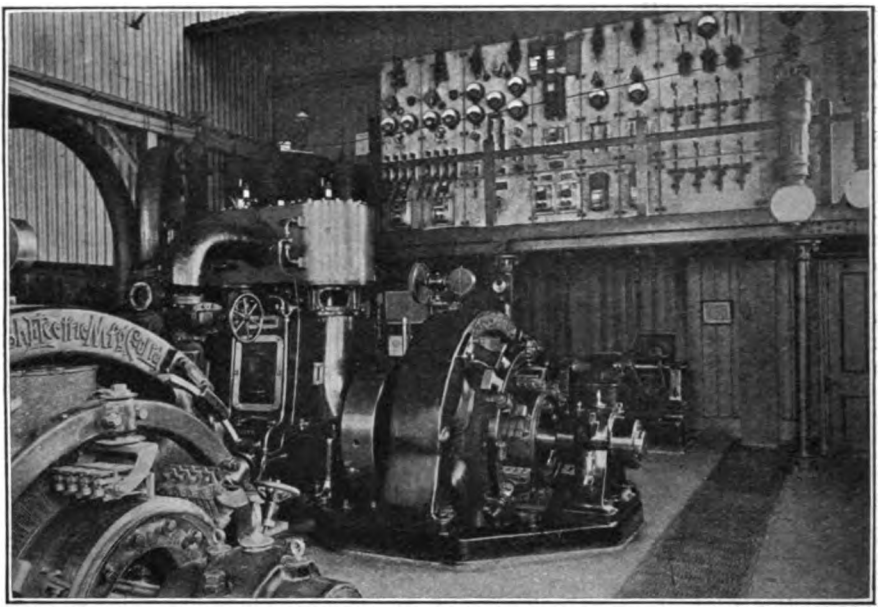
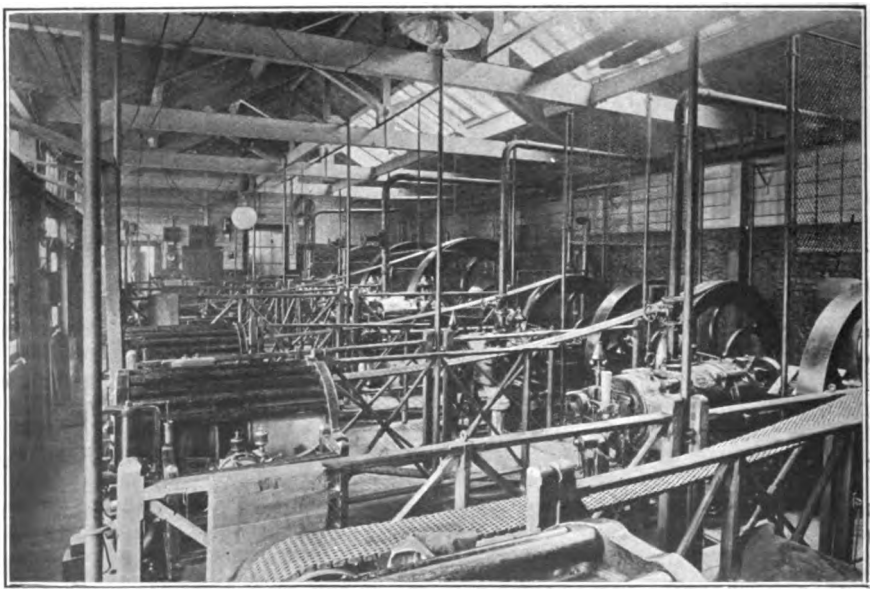


POWER HOUSE: DEPTFORD WHARF.

miles of line where the electric block instruments are inter-locked with the mechanical signals, a very large proportion to be equipped for "lock and block" out of a total mileage, including joint and leased and worked lines, of 457¼. This applies, in fact, throughout the whole of the London district, and for a considerable distance out, as well as for certain sections in other areas. Most of these are signalled by Sykes' instruments, with Tyers' elsewhere. About 20 track circuits have been equipped in conjunction with the signalling at special places.



ELECTRIC POWER HOUSE: WILLOW WALK.

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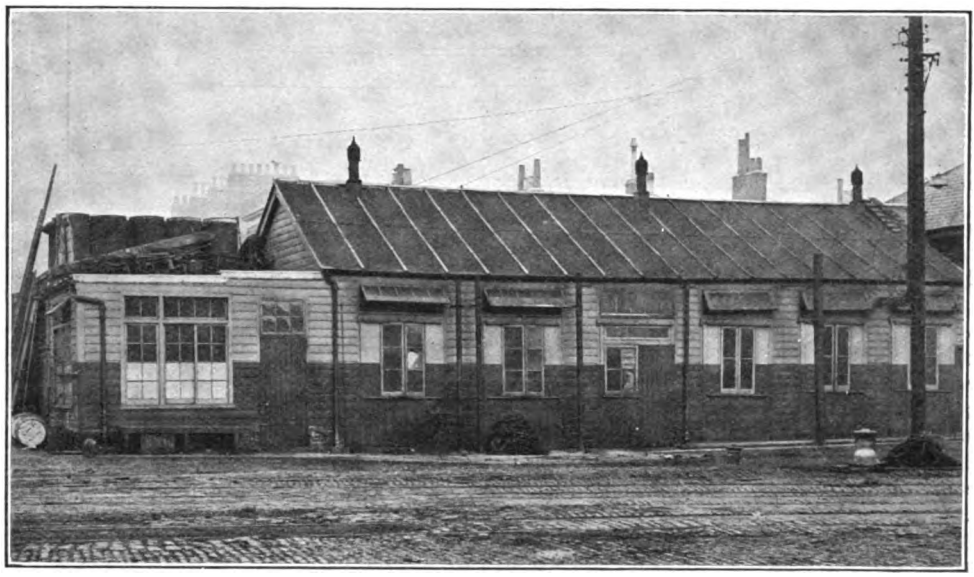
At Victoria station, as is well known, the signalling is electro-mechanical, on the Sykes' system, signals being operated electrically and the points manually. This system is continued down the main line to Battersea Park, the total number of electrically-worked signals being about 200. There are also Sykes' "banner" signals at various places on the system. There are also a few electrically-worked points, though as a general practice points are operated mechanically. For the electric signalling at Victoria two alternative sets of "Chloride" batteries are installed, these being charged by current obtained from the Westminster Electric Supply Corporation. The total signalling equipment in three signal boxes consists of 1,674 separate items, and 54 involved by the electrical signalling equipment associated therewith in the offices. These include 63 telephones and telegraph instruments, 183 repeaters, 22 fog repeaters, 275 signal slides, 192 electric signals, 119 fouling bars and treadles, and 160 detectors. About 120 miles of wire are used for this.

For public telegraphy, a very big factor on this line, about 90 clerks are under the direction of Mr. Houghton, and the record for 1913 was 817,809 post office telegrams dealt with. Even this was exceeded in 1911 when the number was 893,361, which, it is believed, is considerably higher than any other railway in this country. This is, of course, entirely public or public service telegraphy, and is quite apart from the private work of the Company. It is of interest to note that the London, Brighton and South Coast was the first railway company to provide general post office facilities at the station public telegraph offices, this applying to both London Bridge and Victoria stations.

The following telegraphic statistics will be of interest:

Number of telegraphic instruments of all kinds, including block	5,300
Number of telephones for all purposes	1,300
Mileage of wire employed for railway purposes	5,200
Mileage of wire maintenance for the Post Office Telegraph Department	2,367



ELECTRIC POWER HOUSE: WILLOW WALK.

There are telegraph and electric light workshops at New Cross, Battersea, Brighton and Horsham.

Enough has been said to show that the scope of work of the electrical department of the London, Brighton and South Coast Railway is by no means inconsiderable, and includes many interesting features, even if electric traction is placed outside the account. In conclusion we may refer to the gentlemen responsible for the electrical side.

Mr. R. H. Houghton, B.Sc., M.I.C.E., M.I.E.E., the Electrical Engineer, was educated at Dulwich College, and received a comprehensive training in electrical engineering at the City and Guilds Central Institution, South Kensington, obtaining the

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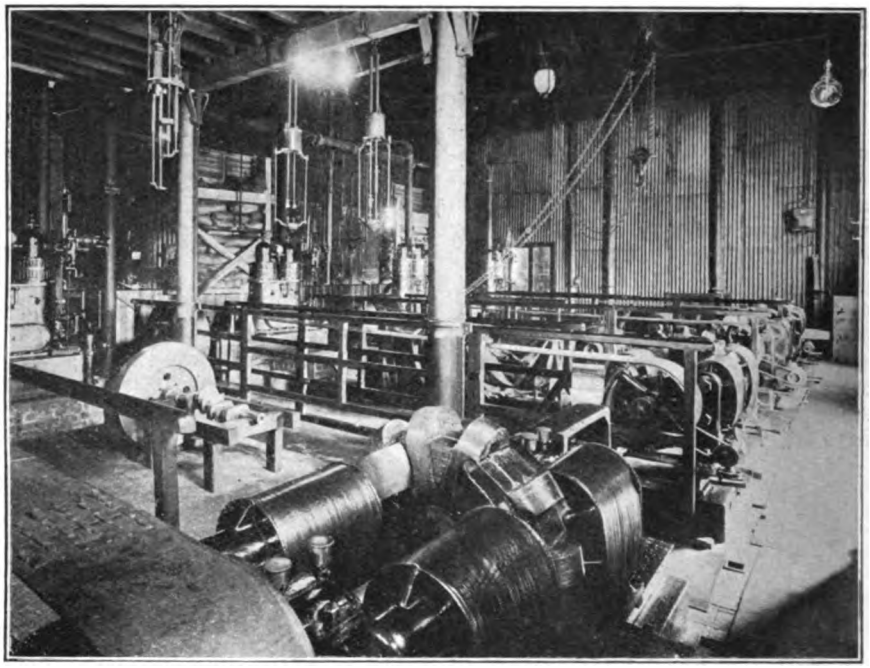

ELECTRIC POWER HOUSE: NEWHAVEN HARBOUR.

B.Sc. degree with honours at London University. He entered the Electrical Department of the London, Brighton and South Coast Railway in 1893, and successively had charge of the electric train lighting, telegraph, and electric light and power work on the railway. In October, 1909, he was appointed Telegraph Superintendent and Chief Electrical Engineer of the Company in succession to his father, who had held the post for over 30 years. In 1912 he was elected a Member of the Institution of Civil Engineers. During his service with the London, Brighton and South Coast Railway several large lighting and power installations on the railway have been carried out under his supervision, also large extensions made to the telephone and lock and block train signalling systems. In addition to the telegraph, electric lighting and power work he has charge of the maintenance of the single-phase electric traction equipment, designed and laid out by the Company's Consulting Electrical Engineer, Mr. Philip Dawson, M.Inst.C.E., M.Inst. E.E., etc.,

The writer has to acknowledge the courteous co-operation of Mr. Houghton (to whom he is indebted for many statistics specially extracted), and of other officers of the London, Brighton and South Coast Railway, in the preparation of this article, and also for the interesting selection of illustrations given herewith

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CHERTSEY: A TYPICAL SUBURBAN STATION.

The Residential Services of the London and South Western Railway.

By J. FRANCIS.

TAKING rank as one of the "great" suburban-traffic lines, the London and South Western Railway is of peculiar interest in this connection because of the wide area involved, and the comprehensive character of the train services concerned mainly or partially with residential travel to and from London daily. It is, in fact, exceedingly difficult to say exactly where residential travel ceases to be a more or less important factor in the traffic of each week-day, and this aspect can be noted on virtually every route out of London, including relatively long distance routes as far as Basingstoke on the main line, to Haslemere towards Portsmouth, to Farnham and to some extent to Alton, and for some distance along the Reading branch, of course including the somewhat complex system of inter-connecting and alternative routes within the area thus limited.

The geography of the London and South Western Railway within 50 miles of London is of special interest. From Waterloo it commences as an 8-track main line, or rather as two substantially distinct four-track main lines, the Windsor section being operated largely independently of the main lines proper. Through Vauxhall and Queens Road portions are 6 or 7 track, but after the spur to the West London Extension Railway is put off there are two four-track sections again at Clapham Junction, with the carriage sidings between and additional lines and platforms on the north side of the station where the Ludgate Hill, Addison Road, South Eastern and Chatham and other trains are dealt with. Thereafter both sections are four-track for some distance, the main line, in fact, right down to Worting Junction, beyond Basingstoke, and the Windsor route to Barnes.

Following the main line, at Wimbledon the first connection from the Windsor route —*viâ* East Putney and Southfields—comes in on the north side, though there is not much through traffic, except for empty trains, goods and specials. On the south side the Tooting and Wimbledon trains, London and South Western from Ludgate Hill and London, Brighton and South Coast from London Bridge, make connection, but here also there is little through working, though on Sundays and once or twice on week days Ludgate Hill trains are continued to Kingston.

At Raynes Park the first of the numerous "burrowing" junctions is met with as the Epsom and Leatherhead route diverges; beyond Malden the Kingston loop is similarly put off. At Surbiton the Cobham route to

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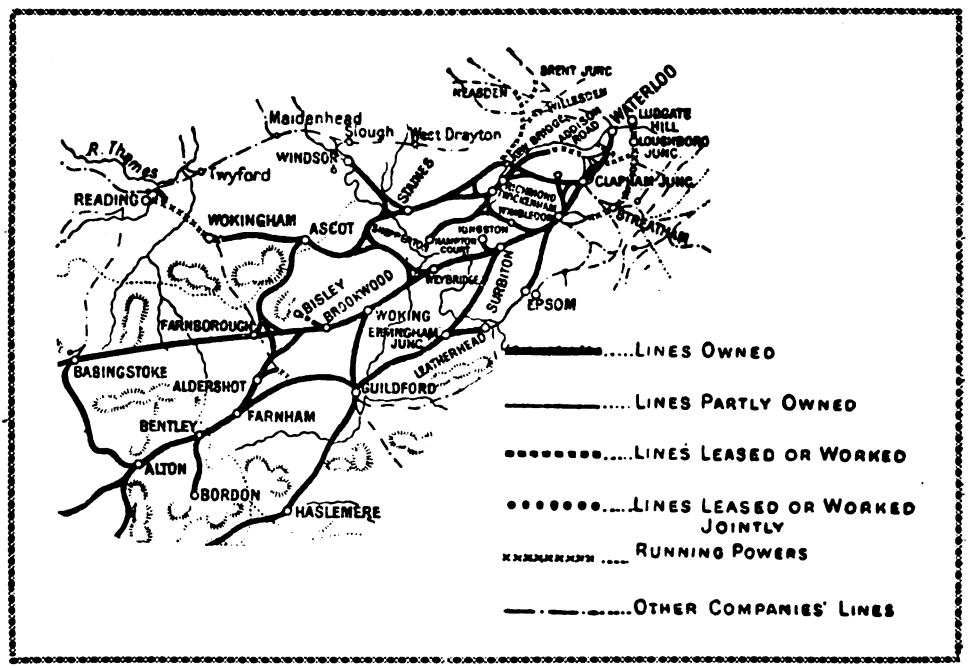
Leatherhead diverges by a "burrowing" junction, and about half a mile further on, at Hampton Court Junction, the Hampton Court branch diverges. Hitherto connection has been made by surface junctions, but the new "flyovers" here are virtually completed and will be brought into use very shortly.

From Weybridge the Chertsey branch connects by surface junctions, but there are only a few through trains by this route. The loop from the Chertsey branch to the main line near Byfleet is, however, of

South of the main lines the Epsom and Cobham routes rejoin at Leatherhead, and at Guildford the Woking line comes in, giving three more or less distinct routes for London-Guildford and Portsmouth trains. Aldershot also has its alternatives, *viâ* the main line and Pirbright Junction (beyond Brookwood station) or *viâ* the Windsor lines and the Ascot and Camberley section.

Following the Windsor lines from Clapham Junction the first divergence, beyond Wandsworth Town, is that of the East Putney and Southfields branch, which rejoins the main



PLAN OF LONDON AND SOUTH WESTERN RAILWAY LINES BETWEEN LONDON AND READING, WINDSOR, BASINGSTOKE, ALTON AND HASLEMERE.

"burrowing" type at the main line end. Woking is too busy a centre to require flying junctions in all directions, but the divergence of the Aldershot line beyond Brookwood is of "burrowing" type. The Bisley branch, as also the private line to the Necropolis (crematorium) station are given ordinary connections, their traffic being usually of a special character. Between Brookwood and Farnborough there is an interesting series of junctions, for in addition to the Aldershot, Bisley and Necropolis divergences, near Farnborough the Ascot and Camberley line has a triple junction to the main lines in both directions, besides passing under the main lines direct to Aldershot.

line at Wimbledon. The Putney Bridge–East Putney line, connecting with this section, including the bridge over the river, is London and South Western property, but is only used by District electric trains. At Barnes, another flying junction is used for the Hounslow loop. Beyond Twickenham there are two triangles, one towards Staines, giving connection in both directions with the Hounslow loop which here rejoins—and the other, beyond Strawberry Hill station, providing for Strawberry Hill–Teddington, Strawberry Hill–Fulwell, and Fulwell–Teddington traffic.

The Kingston loop is continued to rejoin the main line at Malden so that trains can

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and do work right round from Waterloo to Waterloo on a "roundabout" service. This is also possible with the Hounslow and Richmond routes, using the loop of the triangle beyond Twickenham, but this is not often done, though a rail motor car works between Gunnersbury and Twickenham over the connecting portion of this route.

The Gunnersbury–Kew Bridge spur from the Addison Road–Richmond route may here be mentioned, while the system of connecting lines, in the ownership of which several companies are concerned, in the South Acton–Gunnersbury district enables North London, London and North Western and District trains to reach Richmond, and in the case of the two former, Kew Bridge. Together with Midland goods trains, which also penetrate this area, while the London and South Western goods traffic over the North and South Western Junction Railway is an important factor, the traffic in this complicated area is considerable, though passenger trains are relatively few, except for District trains to Richmond. During the movements of troops these lines have proved exceptionally useful, as, in conjunction with the London and North Western and North London Railways, through routes are available, without passing through the thick of London traffic, between every railway in the Metropolis and the London and South Western system.

At Staines, another triangular junction enables trains to diverge to Windsor or Reading, or to run direct from Windsor towards Ascot, while still another triangular junction at Virginia Water interconnects the Reading line in both directions with the Chertsey branch. From Ascot the Camberley line branches off towards Farnborough or the Aldershot line.

The general features of this complication of lines can, however, only be effectively realised by reference to the map on page 274, from which the multiplicity of routes rendered available for almost any train will be apparent. Virtually all possibilities are utilised for goods, specials, light engines and empty trains, but for standard passenger traffic they are only partially employed.

To Guildford, many trains are run regularly over all the three routes above mentioned, though the Haslemere and Portsmouth trains travel *viâ* Cobham or *viâ* Woking; but most of the Aldershot and Farnham regular trains are sent *viâ* the main line and Pirbright Junction. The Kingston loop is in regular use for suburban trains making complete or partial "roundabout" journeys; but otherwise ordinary trains usually follow the respective direct routes at the Twickenham and Strawberry Hill triangles, the exceptions being usually rail motor car or local connecting services. There are, however, regular services *viâ* the Hounslow loop to Feltham, Staines and beyond.

The Staines and Virginia Water triangles again are not used by varied route trains, except for the Windsor–Woking cross-country services. From Ascot the trains through Camberley are virtually of a branch character, but in this case, as also in certain other instances, a particular engine and vehicles may actually make an involved and "roundabout" journey, though not appearing to do so from the public point of view. Certain special Waterloo–Aldershot or Basingstoke trains are, however, operated this way on a continuous journey, and some of these trains will require attention on this account.

The standard train service routes involved in this traffic may be classified as follows:

(*a*) Main line between Basingstoke and London;
(*b*) Alton, Farnham and Aldershot routes;
(*c*) Guildford routes;
(*d*) Virginia Water, Ascot, Camberley and Reading routes;
(*e*) Windsor route.

These require to be further classified accordingly to cover the

(1) Cobham-Leatherhead route;
(2) Richmond routes;
(3) Hounslow routes;
(4) Kingston loop;
(5) Southfields and Wimbledon branch;
(6) Shepperton branch;
(7) Hampton Court branch;
(8) Weybridge-Chertsey branch; and
(9) Raynes Park-Leatherhead route.

In addition there are the Ludgate Hill-Clapham Junction (or Addison Road), and Ludgate Hill-Wimbledon services; the Clapham Junction-Addison Road-Richmond services; and the Gunnersbury-Twickenham services; together with several alternatives, rendered available because of various connecting lines and loops. These are, however, of local interest mainly, and while the trains render good service, they are involved only in a secondary degree in what may be

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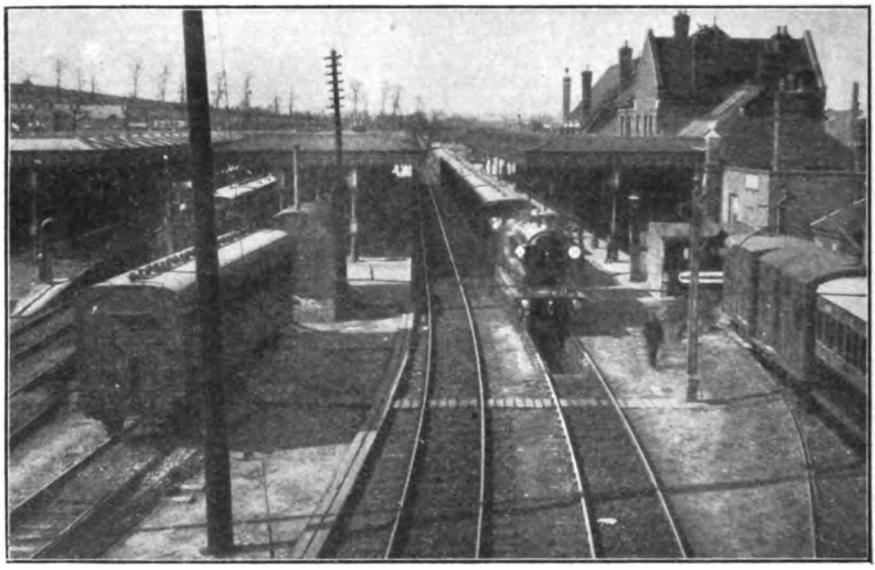
termed the more interesting features of suburban traffic working.

On the London and South Western Railway, longer-journey facilities which meet the needs of business people who travel to and from town every or nearly every week-day, constitute a very important factor, there being large numbers of people who reside from 20 to nearly 50 miles from town and travel up and down daily or several times a week. It is true that some of this traffic is dealt with by trains which have ordinary work also to perform; including expresses, semi-fasts and secondary long-distance trains; but in many respects the schedules given to them indicate their value from the residential point of view.

During the summer months there are several excursion or holiday trains taking special routes; but by reviewing the winter services it is possible to confine attention with substantial accuracy to the business travel. It will, of course, be understood that the subject is dealt with from the standard point of view, and without reference to the special features and modifications incidental to the present situation.

To a large extent one may say that the London and South Western ordinary suburban traffic is built up around the Kingston loop, the intermediate stations—Norbiton, Kingston, Hampton Wick, Teddington and Strawberry Hill—being in special favour from the residential point of view. These districts, largely riverside, constitute, in fact, extremely desirable residential districts, and their traffic is catered for correspondingly.

A large number of trains are operated as "roundabouts," though a ten or fifteen minute stop at Kingston may render the two stages distinct. Many, indeed, actually run as "roundabouts," with only a two or three minute stop at Kingston. From the public point of view, however, they are trains for these stations to and from Waterloo *viâ* Wimbledon or *viâ* Twickenham, and besides the Waterloo–Waterloo trains there are others which terminate at Strawberry Hill, Teddington or Kingston, from either direction. In combination, however, they give these stations very good facilities, besides which they participate in the Richmond traffic on one side and the Malden, Raynes Park and Wimbledon traffic on the other.



Photo] [*K. T. Smith.*

ISLE OF WIGHT EXPRESS IN GUILDFORD STATION.
4-4-0 locomotive No. 425.

Both ways interesting fast business services are given. Thus, *viâ* Wimbledon, there are more or less fast trains from Kingston at 7.30, 7.42, 8.8, 8.35, 8.53, and 9.37 a.m., to Waterloo, besides several others which omit one or more stations, and a few slows. All call at Norbiton, and except for Vauxhall stops, the most interesting are the 7.30 (calling at

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Wimbledon only), 7.42 (Malden and Wimbledon only), 8.8 (non-stop Malden to Vauxhall), and the 8.53 and 9.37, both non-stop Norbiton to Vauxhall. Moreover, all of the trains suited for the business pressure to town, except the 8.14 and 8.28 a.m. from Kingston, start from Teddington, or are through trains from Twickenham or "roundabouts," so that other stations mentioned are correspondingly served.

On Saturday afternoons the best trains are the 1.25 p.m. (non-stop Waterloo to Malden in 20 minutes), and the 1.55 p.m. (non-stop to Raynes Park); but on other week-days the 4.50, 5.35 (non-stop to Norbiton in 21 minutes), 6.7 (non-stop to Wimbledon, and peculiar as a through train to Shepperton by this route), 6.24 (non-stop to Malden), and 7.5 (Earlsfield and Raynes Park only to Norbiton) are really good trains. A late theatre train at 11.42 p.m., non-stop to Norbiton, constitutes by no means the least important feature of the service. An interesting characteristic of the Sunday services is a regular hourly "roundabout," series of trains, (nearly all pass Earlsfield, Wandsworth Town and Queens Road stations), with a few extras and earlier and later trains as required.

Viâ Richmond the Kingston trains are involved with others in giving facilities between Twickenham, Richmond and other stations and Waterloo, whether "roundabouts" or starting from or terminating at Kingston. Many of them pass one or more stations between Twickenham and Vauxhall, but none of the morning trains on the Kingston service call for special reference, the best facilities being given *viâ* Malden. In the opposite direction the most interesting trains from Waterloo are the 4.47 p.m. (Putney, Mortlake and Richmond only to Twickenham), and the 6.55 p.m. (non-stop to Barnes), in addition to semi-fasts as on the up journey.

Except for one or two trains *viâ* Kingston —the 6.7 p.m. from Waterloo has been already mentioned—the Shepperton route is mainly served *viâ* Twickenham. In a few cases combined trains are run, consisting of two of the usual 4-bogie unit suburban trains divided or joined at Twickenham or Strawberry Hill, or the trains run in connection with others at Twickenham. At business hours, however, the Shepperton trains are treated independently and some really good fasts are given.

From Shepperton the 7.26 a.m. calls only at Mortlake between Twickenham and Vauxhall. The 7.55 a.m. is non-stop from Mortlake right into Waterloo (this being one of the very few up suburban trains which passes Vauxhall). The 8.17 and the 8.35 a.m. trains are semi-fasts, while the 9.0 a.m. is notable for running fast from Richmond to Vauxhall. The 9.25 and 10.0 a.m. trains are rather slower, but the 10.38 a.m. gives a good late business service, non-stop Richmond to Vauxhall.

In the opposite direction there are several exceptionally good trains from Waterloo as follows:

1.10 p.m. (Sats.) Non-stop to Twickenham.
4.5 p.m. Non-stop to Mortlake.
5.0 p.m. (Not Sats.) Non-stop to St. Margarets. This is a combined Shepperton and Windsor train.
5.45 p.m. (Not Sats.) Non-stop to Richmond.
6.35 p.m. Non-stop to Richmond.
11.50 p.m. Non-stop to Richmond. Combined Windsor and Shepperton train.

Some of these also pass St. Margarets, while there are, of course, various semi-fasts.

Although Windsor trains usually serve at least two or three intermediate stations, at business hours there are several expresses presenting unusual features. A few of these trains travel *viâ* the Hounslow loop, but the semi-fasts are generally utilised to give Twickenham and Richmond good trains.

The 7.29 a.m. from Windsor calls only at Richmond between Ashford and Vauxhall. The 8.17 a.m. travels *viâ* Hounslow, and passes Feltham and stations between Chiswick and Vauxhall. The 8.36 is an interesting and somewhat peculiar train, as it calls only, after Wraysbury, at Feltham, St. Margarets, Richmond and Mortlake, thence running right into Waterloo. Its stops are thus selected, as the Staines and Ashford traffic is taken by a Reading train immediately following.

At 9.28 is one of the best trains, non-stop Staines Junction to Vauxhall in 27 minutes. The 9.53 is a semi-fast, while the 11.5 a.m. is a late express to Waterloo in 45 minutes, with calls only at Datchet and Staines to Vauxhall.

On Saturday afternoons the following trains from Waterloo may be specially mentioned:

1.18 p.m. Fast Clapham Junction to Richmond, thence slow.
2.3 p.m. Fast to Richmond, and Twickenham to Staines.

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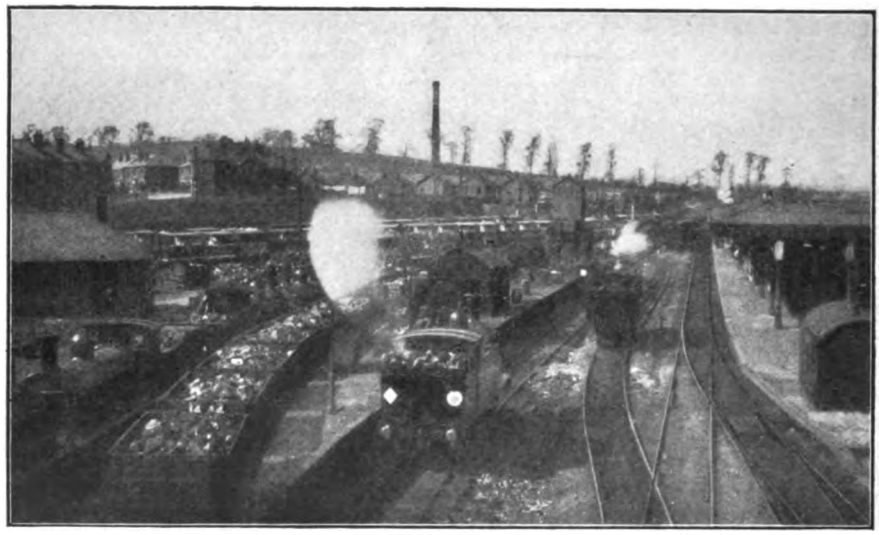
On other days the most interesting trains are :

4.45 p.m. Fast to Staines, combined Windsor and Reading train.
5.0 p.m. Fast to Mortlake, combined Shepperton and Windsor train.
5.40 p.m. Fast to Feltham, combined Windsor and Reading train.
6.2 p.m. Fast to Richmond.
6.40 p.m. Fast Vauxhall to St. Margarets, combined Windsor and Reading train.

The late 10.45 and 11.50 p.m. combined trains, both fast to Richmond, are also fairly good trains. The trains mentioned are, of course, in addition to semi-fasts and slows.

On Saturdays the 1.15 p.m. from Waterloo is non-stop to Ashford in 29 minutes. The 1.40 p m. semi-fast only goes as far as Ascot, while the 2.10 p.m. does not get any lengthy non-stop run. On other week-days interest commences with the 3.38 p.m. from Waterloo, non-stop to Staines Junction. The next important train is one of those specially routed, the 4.40 p.m., which calls first at



Photo] [*K. T. Smith.*

COALING AND ENGINE SIDINGS AT GUILDFORD.

Between Staines Junction and Reading almost all trains call at every station, but besides the through Reading trains there are also a few which terminate at Virginia Water, or proceed from Ascot *viâ* Bagshot and Camberley to other routes. Of the morning trains the following may be referred to. The 6.53 a.m. from Reading calls only at Richmond after leaving Ashford, thus giving Staines and Ashford a good fast train. The 7.55 a.m. does still better, as it makes the Ashford—Vauxhall run without stop in 24 minutes. A further extension of non-stop running is given by the 8.30 a.m. from Farnham, one of the special route trains previously mentioned which, travelling *viâ* Camberley, makes its last call at Virginia Water at 9.27, thence running non-stop right into Waterloo, due at 10 a.m. The 8.51 a.m. from Reading is combined with a Windsor train at Staines Junction, and thence runs non-stop to Vauxhall, while the 9.45 a.m. from Reading makes the Ashford—Vauxhall run without intermediate stop.

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Besides the long-distance trains there are also some which start from or terminate at Feltham, or Staines Junction, and these are

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more generally interwoven with the Hounslow loop services, while they are also concerned in giving Richmond and other stations the good facilities afforded by the combination of train routes available therefor. Some of the Hounslow trains run to or from Feltham, one or two reverse into Twickenham instead, but the majority are either operated as throughs *viâ* this route, or run only between Hounslow and Waterloo. There is no need to review these, or the complete Richmond services in detail, as there are so many trains which omit one or more stations, and most of the special fasts have received attention already on other grounds. It will, however, be interesting to analyse the general value of all these facilities, on the ground of the more or less fast trains given at the hours of business travel to or from Waterloo. The result is perhaps as good a testimony as to the quality of London and South Western suburban services and residential services as could be wished for. Only stations having an individual importance are mentioned, though in several cases one or more other stations share in the same facilities with a few minutes added or taken off according to their position with reference to stations mentioned.

	Distance. Miles.	Best Times. Up. min.	Down. min.
Putney	6	14	13
Barnes	7¼	16	12
Mortlake	8¼	15	16
Richmond	9¾	20	19
St. Margarets ..	10¾	24	21
Twickenham ..	11½ (*b*)	25	19
Hounslow	13½	34	29
Strawberry Hill ..	12¾ (*b*)	30	24
Teddington	13¾ (*a*)	33	31
Shepperton	19 (*b*)	48	43
Kingston	12¼ (*a*)	26	23
Norbiton	11¼ (*a*)	23	21
Malden	9¾ (*a*)	21	22
Feltham	15	33	24
Ashford	17½	29	30
Staines Junction ..	19	31	29
Wraysbury	21½	45	41
Datchet	24	40	46
Windsor	25¾	45	51
Egham	21 (*b*)	37	36
Virginia Water ..	23¼ (*b*)	33	36
Ascot	29 (*b*)	48	53
Bagshot	32¼ (*b*)	54	60
Reading	43½	85	98

(*a*) *viâ* Wimbledon.
(*b*) *viâ* Richmond.

Space does not permit of detailed analysis as to the numbers of good trains, but at nearer stations they are numerous at periods when traffic is heavier, and by no means infrequent at others, while to meet the demands of the pressure to and from the Metropolis the "best" times given above are often equalled or nearly approached by more than one train. In fact, the isolated best times are given mainly to more distant stations, where one specially fast train is generally sufficient.

As regards the incidental routes associated with the Windsor section, it will be sufficient to mention the Ludgate Hill–Clapham Junction–Addison Road–Richmond services, the Gunnersbury–Twickenham rail motor cars, the Ludgate Hill–Wimbledon trains (a few of these are fairly fast on the South Eastern and Chatham Railway), and the Waterloo–East Putney–Wimbledon trains, a few of which are fast to the extent of missing one or more stations. Further afield, the Windsor–Woking, Weybridge–Chertsey or Virginia Water, Ascot–Woking or Aldershot and Farnham services, are more or less local or are associated with London trains already referred to.

Dealing now with the main line suburban services, the Hampton Court section presents several features of interest. For the morning pressure there are trains at 7.30, 7.48, 8.12, 8.42, 8.59, 9.23, 9.56 and 10.10, 10.48 and 11.20, of which the 7.30, 8.42, 8.59, 9.56, 10.48 and 11.20 are more or less fast. The best are the 7.30 a.m. (non-stop Malden to Vauxhall) and the 9.56 and 11.20, both non stop Surbiton to Vauxhall. The distance from Hampton Court to Waterloo is 15 miles, but the 7.30, 8.42, 8.59, 9.56 and 11.20 take under 40 minutes, and the best time is 34 minutes by the 11.20 and 35 minutes by the 9.56.

Down, owing to the omission of the Vauxhall stop, the 1.30 p.m. on Saturdays, non-stop to Surbiton in 20 minutes, gives a 30-minute train to Hampton Court, while on other weekdays the 5.40 and 6.10 p.m. trains, also non-stop to Surbiton, are scheduled in 32 and 31 minutes respectively to the branch terminus. Other good trains are the 5.5, 6.41, 7.0 and 9.0 p.m. A feature of the Sunday service on this route is that hourly trains are run each way, from 8.10 a.m. until 11.10 p.m. down, and from 7.10 a.m. to 11.10 p.m. up, with a few extras, including the 12.15 (midnight) down.

Dealing now with the Guildford routes, there are two more or less distinct services, *viâ* Leatherhead and *viâ* Oxshott, besides the direct Woking–Guildford trains. Virtually all stations are in residential favour, both routes passing through most attractive country. Besides the through trains there are a few which start from or terminate at

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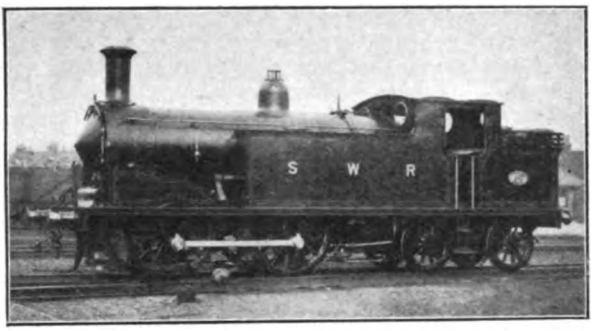


ONE OF MR. DRUMMOND'S STANDARD 0-4-4 SUBURBAN TANK ENGINES.

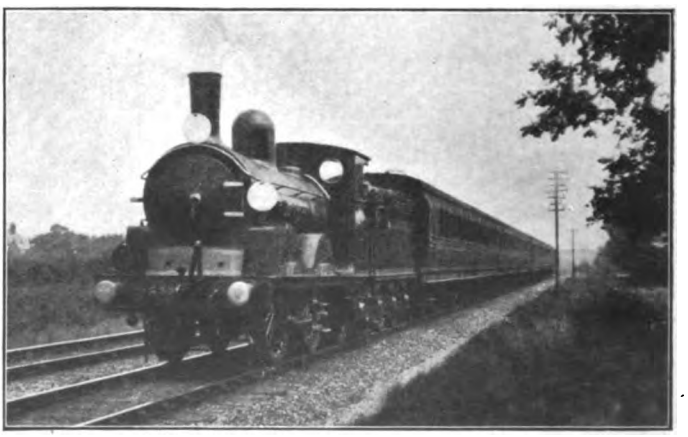
Epsom, Leatherhead, Bookham, Effingham Junction or Horsley.

Viâ Epsom, there are morning trains from Leatherhead at 7.15, 7.51, 8.16, 8.35, 8.53, 9.29, 9.35 and 9.57 a.m. suited for traffic to town, and all except the 8.53 pass at least one station *en route*. The 8.16 from Leatherhead, starting from Bookham at 8.10, is notable as one of the two special Epsom fasts, non-stop therefrom to Vauxhall in 19 minutes. A local from Epsom follows this, to give Ewell and Worcester Park corresponding facilities, semi-fast in this case. The second Epsom fast is the 9.29 from Leatherhead (starting from Horsley at 9.13 a.m.) and this runs from Epsom right into Waterloo in 25 minutes, a semi-fast from Leatherhead at 9.35 giving other stations required facilities. On Saturday afternoons the 1.21 and 2.5 (first stop Worcester Park), trains are the best, while the evening pressure is catered for by the 4.30, 5.25 (non-stop to Epsom in 26 minutes), 5.28, 6.32 (non-stop to Raynes Park) and other slow or semi-fast trains, culminating in a midnight semi-fast to Leatherhead.

On the Oxshott route the trains are largely fast between Vauxhall or Clapham Junction and Surbiton (sometimes with a Wimbledon call also), so that there is little special need, beyond providing a sufficiency of trains, for specially fast working. Moreover, the distances involved and the character of the districts served demand only a reasonably frequent service, so that the 7.17, 7.45, 8.36, 9.10 (passes Horsley and Effingham Junction) and 9.55 a.m. trains from Guildford are sufficient for this route, though between Guildford and Effingham Junction passengers also have the 8.15 and 9.23 a.m. trains *viâ* Leatherhead at their disposal. Down, the 12.30, 1.37 (as far as Horsley only) and 2.15 p.m. trains on Saturdays may be mentioned, with, as extras, the 2.35 p.m. Portsmouth train, which calls only at Clapham Junction, Surbiton, Cobham, Horsley and London Road, to Guildford, and the 3.45 p.m. as a still better train calling at Cobham only to Guildford.

For the evening traffic the 4.30 p.m. makes its first call at London Road, Guildford in 43 minutes (28½ miles), the 4.40, 5.20 and 6.15 trains run non-stop to Surbiton, and the 6.50 is corresponding fast for stations to Horsley. There are also other trains, and the 11.45 p.m., Clapham Junction, Surbiton and stations to Cobham, may be specially noted.

Guildford itself gets also the Portsmouth trains *viâ* Woking, while stations beyond, as far as Haslemere at any rate, are frequently best served by that route except for a few fast trains travelling *viâ* Leatherhead or Cobham as already noted. For residential traffic to town the 7.20, 8.11, 8.47, 9.10, 9.48 and 10.9 a.m. trains from Haslemere are available. Of these the 7.20 a.m. joins a main line train at Woking and is thence non-stop right into Waterloo; the 8.11 is a



Photo] [*R. W. T. Collins.*

LOCAL TRAIN NEAR ASHSTEAD.
0-4-2 locomotive No. 638.

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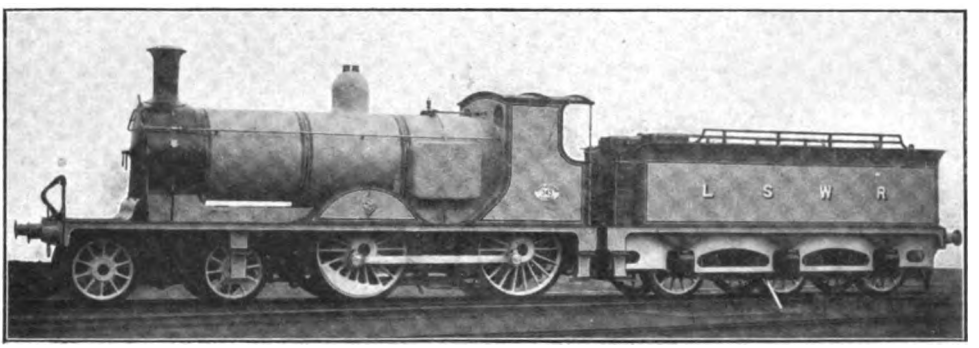
through Portsmouth train, passing Worplesdon only (this station is served by the 7.46 local from Haslemere) to Woking, there joining a main line train non-stop to Vauxhall; the 8.47 a.m. from Haslemere is the 7.55 a.m. Portsmouth breakfast car train, and calls only at Godalming and Guildford, thence running non-stop to Vauxhall; the 9.10 comes from Midhurst and at Woking is joined with the 9.17 a.m. from Basingstoke, non-stop Woking to Waterloo; the 9.48 from Haslemere is a through *viâ* Cobham and Surbiton; and the 10.9 is a through train *viâ* Woking, though Guildford itself is best served by the following Portsmouth express, which calls at 10.57 a.m. and reaches Waterloo at 11.39 a.m. The 9.27 from Guildford is a fairly good train for Guildford, Worplesdon and main line stations. It is worthy of note that Guildford residents can leave London as late as 12.15 (midnight), and on Wednesday nights this service is continued through to Haslemere.



ONE OF MR. DRUMMOND'S 4-4-0 MIXED-TRAFFIC LOCOMOTIVES, A CLASS LARGELY EMPLOYED FOR THE LONGER JOURNEY SUBURBAN AND SECONDARY SERVICES.

On Saturday afternoons the 12.45 a.m. Portsmouth luncheon car express gives Guildford a non-stop train, with the 1.17 and 2.35 for various stations and the 1.20 and 2.28 as far as Guildford. Later in the day the 4.30 (first stop Guildford, thence Godalming, Haslemere and stations beyond, a division from Guildford serving Farncombe, Milford and Witley), 4.55 (Woking, Guildford, Haslemere and beyond), 5.3 (Clapham Junction, Woking and beyond as far as Petersfield), 5.45 (Woking, Guildford and beyond), 5.55 (Woking, Worplesdon and Guildford only), 6.40 (Portsmouth Dining Car express, Guildford and Haslemere only), and 6.45 (Woking, Worplesdon and Guildford only).

Dealing now with the morning traffic from main line stations, Basingstoke to Esher inclusive, an interesting series of trains may be noted. The business pressure may be said to commence with the 7.50 a.m. from Chertsey, all stations to Surbiton, thence fast to Vauxhall, arrive at Waterloo at 8.43 a.m. Following this is the 7.13 a.m. from Basingstoke (a Southampton train), which is attached at Woking to the 7.20 a.m. from Haslemere, and then runs non-stop to Waterloo, due at 8.44 a.m. Between them, these two trains serve every station beyond Basingstoke along the main line except Byfleet. A few minutes later the 7 30 a.m. from Alton follows the Basingstoke train from Pirbright Junction, giving Brookwood and Woking a following fast train, and this calls at Byfleet at 8.29, and serving Walton and Surbiton, reaches Waterloo at 9.14 a.m. The 8.31 a.m. from Chertsey gives another train for all stations to Surbiton, thence fast; and shortly behind this is the 8.45 a.m. from Woking, serving Byfleet and Weybridge (connecting train from Virginia Water) thence fast to Vauxhall, due Waterloo, 9.30 a.m. Intervening stations are served by the 9.5 a.m. from Walton, which is essentially a Walton, Esher and Surbiton fast.

The latter is passed by the 6.53 a.m. Portsmouth train, combined at Woking with the 8.1 a.m. from Basingstoke (a Southampton train), and is thence non-stop to Vauxhall, reaching Waterloo at 9.34 a.m. Behind this is the 8.23 a.m. from Ascot, *viâ* the loop line, which gives Brookwood, Woking and Byfleet a fast to Clapham Junction (due Waterloo, 9.48 a.m.). By the 5.50 a.m. from Yeovil, Basingstoke gets an express at 8.59 a.m., calling only at Farnborough to Surbiton (due Waterloo, 10.11), this train

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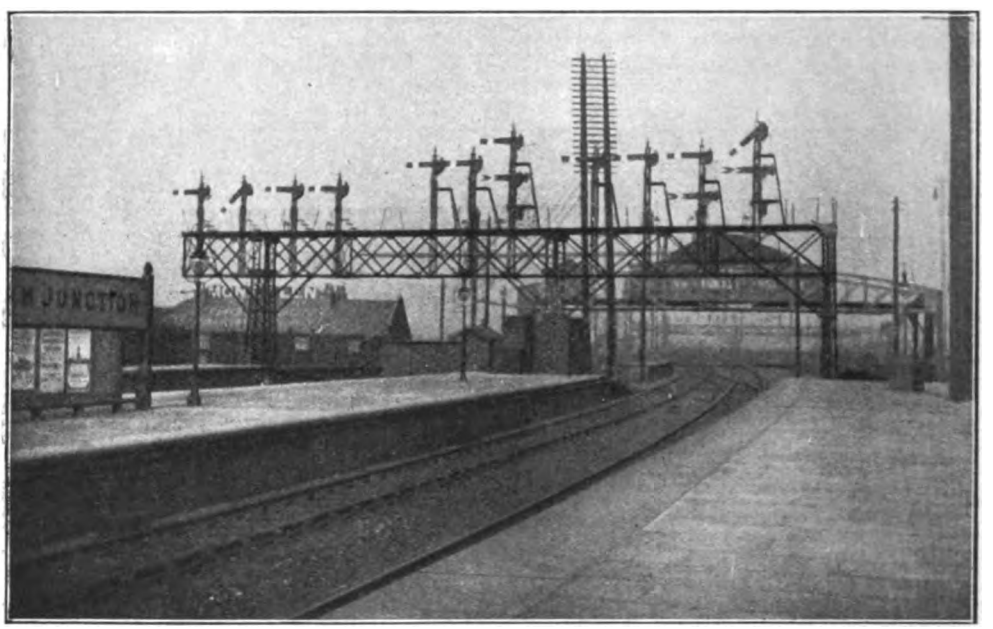
passing the 9.22 a.m. from Woking, all stations to Surbiton, thence fast. The latter train is also passed by the 6.55 a.m. from Southampton, *via* Alton and Farnham, which, serving Brookwood and Woking, is thence non-stop right into Waterloo at 10.13 a.m.

Although this is late enough for most ordinary business traffic, these longer journeys often require arrivals up to about 11 o'clock, so that four other trains also require mention. These are the 9.27 a.m. from Guildford (9.47 a.m. from Woking), serving Byfleet, Weybridge and Surbiton to Vauxhall; the combination of the 8.38 a.m. from Petersfield and the 9.17 a.m. from Basingstoke, non-stop from Woking to Waterloo (this train is notable in that it passes Brookwood, one of the most important long-distance residential stations); the 9.33 a.m. from Alton, non-stop from Brookwood to Vauxhall in 33 minutes; the 9.58 a.m. from Basingstoke (8.50 a.m. from Southampton Town), which calls at Farnborough and Vauxhall, and yet arrives at Waterloo in 61 minutes.

It will be interesting to analyse these facilities, considering only, for the moment, stations on the main line. The number of stops to Waterloo is given in brackets. As a rule, at least one of the stops made is at Vauxhall, except where *a* denotes that this stop is not included.

Basingstoke—7.13 (6*a*), 8.1 (7), 8.59 (3), 9.17 (5*a*), 9.58 (2).
Hook—7.23 (5*a*), 8.11 (6), 9.26 (4*a*).
Winchfield—7.30 (4*a*), 8.19 (5), 9.33 (3*a*).
Fleet—7.36 (3*a*), 8.26 (4), 9.40 (2*a*).
Farnborough—7.44 (2*a*), 8.33 (3), 9.19 (2), 9.47 (1*a*), 10.18 (1).
Brookwood—7.55 (1*a*), 8.13 (5), 8.43 (2), 8.54 (4), 9.27 (1*a*), 10.18 (1).
Woking—8.10 (0*a*), 8.22 (4), 8.45 (3), 8.58 (1), 9.5 (3), 9.22 (6), 9.37 (0*a*), 9.47 (4), 10.5 (0*a*).



UP WINDSOR STARTING SIGNALS AT CLAPHAM JUNCTION.
British Pneumatic Railway Signal Co.'s Low Pressure Pneumatic System.

Byfleet—8.29 (3), 8.52 (2), 9.11 (2), 9.28 (5), 9.54 (3).
Weybridge—8.1 (4), 8.42 (4), 8.59 (1), 9.36 (4), 10 (2).
Walton—8.7 (3), 8.39 (2), 8.54 (3), 9.5 (3), 9.42 (3).
Esher—8.13 (2), 9.0 (2), 9.12 (2), 9.49 (2).

From this it will be seen that while passengers from stations beyond Farnborough have only about hourly trains, all fairly good, however, Basingstoke has its special express at 8.59 a.m.; Farnborough gets a good series at 8.33, 9.19, 9.47 and 10.18 a.m.; Brookwood has even better facilities at 7.55, 8.13, 8.43, 8.54, 9.27 and 10.18 a.m.;

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Woking has a still more amplified series of good trains at 8.10 (non-stop), 8.22, 8.45, 8.58, 9.5 (non-stop to Vauxhall), 9.22, 9.37 (non-stop), 9.47 and 10.5 (non-stop) a.m.; Byfleet is served at 8.29, 8.52, 9.11, 9.28 and 9.54 a.m.; Weybridge at 8.1, 8.42, 8.59 (non-stop to Vauxhall), 9.36, and 10 a.m.; Walton at 8.7, 8.39, 8.54, 9.5 and 9.42 a.m.; and Esher at 8.13, 9, 9.12 and 9.49 a.m. Bearing in mind the distances involved these are exceptionally good facilities. The Chertsey branch gets trains at 7.50, 8.31, 8.46, 9.20, 9.46 and 10.5 a.m. from this station, either throughs or connections.

For the Saturday afternoon pressure the various stations get fast trains from Waterloo as follows:

Esher—1.20 (1), 1.50 (1), 2.28 (1).
Walton—1.20 (2), 1.50 (2), 2.28 (2).
Weybridge—1.16 (1), 1.20 (3), 1.50 (3), 2.28 (3).
Byfleet—1.10 (2), 1.33 (1), 2.28 (4).
Woking—12.50 (2), 1.10 (3), 1.17 (0), 1.20 (4), 1.33 (2), 2.20 (0), 2.28 (5), 2.45 (2).
Brookwood—1.10 (4), 1.33 (3), 2.20 (1), 2.28 (6).
Farnborough—12.50 (3), 1.33 (4).
Fleet—12.50 (4), 1.33 (5).
Winchfield—12.50 (5), 1.33 (6).
Hook—12.50 (6), 1.33 (7).
Basingstoke—12.50 (7), 2.10 (0), 2.20 (1), 2.45 (3).

The evening services are even more notable:

Esher—5.20 (1), 6.5 (0), 6.20 (1), 6.50 (1).
Walton—5.8 (2), 5.20 (2), 6.5 (1), 6.20 (2), 6.50 (2).
Weybridge—5.8 (3), 5.20 (3), 6.5 (2), 6.20 (3), 6.50 (3).
Byfleet—5.3 (1), 5.20 (4), 6 (0), 6.20 (4).
Woking—4.55 (0), 5.0 (0), 5.3 (2), 5.20 (5), 5.30 (0), 5.45 (0), 5.55 (0), 6.0 (1), 6.20 (5), 6.15 (0).
Brookwood—5.0 (1), 5.3 (3), 5.30 (0), 6.0 (2), 6.45 (1).
Farnborough—5.0 (2), 6.0 (2), 6.45 (1).
Fleet—5 (3), 6 (3), 6.45 (2).
Winchfield—5 (4), 6 (4), 6.45 (3).
Hook—5 (5), 6 (5), 6.45 (4).
Basingstoke—5 (1), 5.50 (1), 6 (6), 6.45 (5).

It should be noted that in the case of the 5.0, 6.0 and 6.45 p.m. trains Brookwood is passed, and served by a connecting portion from Woking.

A few remarks will be sufficient to deal with the Farnham and Aldershot branch. For up traffic the three trains of business interest are the 7.30 and 9.33 a.m. from Alton and the 6.55 a.m. from Southampton, the two latter giving good times into Waterloo. The trains themselves have been included above insofar as they serve main line stations, so that it will be sufficient to give the number of minutes occupied into town as follows:

Farnham—8.59 (74), 9.52 (67).
Aldershot—9.10 (63), 10.1 (58).
North Camp—9.17 (56), 10.8 (51).

In the opposite direction the 1.10 p.m. is a fairly good train, while the 2.20 gives an express service in about the hour for North Camp and Aldershot on Saturdays. On other days the business trains are the 5.3, 5.30 (62 min. to Aldershot), 5.55 (61 min. to Aldershot), and 6.45 p.m. trains.

In conclusion a table somewhat similar to that given in reference to Windsor lines traffic will be of interest:

	Distance. Miles.	Best Times. Up. min.	Down. min.
Esher	14½	30	24
Walton	17¼	35	28
Weybridge	19½	31	30
Byfleet	21¾	43	34
Woking	24½	35	32
Brookwood	28	41	43
Farnborough	33½	46	52
Fleet	36½	60	59
Basingstoke	48	54	60
Chertsey	22½	45	42
Hampton Court	15	34	30
Guildford (*a*)	30	—	49
„ (*b*)	30½	42	41
Cobham	18¾	42	30
Horsley	22½	51	48
Epsom	14½	25	26
Leatherhead	18½	36	36
Aldershot (*b*)	35½	55	62
Farnham (*b*)	38½	66	68
Worplesdon	26¾	43	43
Godalming (*b*)	34½	54	58
Haslemere (*b*)	43	68	66

(*a*) *viâ* Horsley.
(*b*) *viâ* Woking.

In large measure these trains, except such as are actually long distance trains over one or other of the numerous routes operated by the London and South Western company, are worked by the ordinary tank engines, or by the well-known mixed-traffic 4-4-0 locomotives. At one time Mr. Adams' 4-4-2 tank engines were extensively favoured for the Windsor and Reading fasts, but now the Drummond engines obtain the largest share of the more interesting work, though the Adams 0-4-4 (5 ft. 6 in. classes) and 4-4-2 tank engines are still widely employed.

It is also worthy of notice that virtually the whole of the main lines, from Clapham Junction to Basingstoke, is power signalled on the British Pneumatic Railway Signal Co.'s low pressure pneumatic system, in some cases all-pneumatic, in others electro-pneumatic automatic and semi-automatic.

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Some Features of American Railway Signalling.

By T. S. LASCELLES.

OUR American cousins, with their usual energy and ingenuity, have made great strides in recent years in signalling apparatus, and there are several interesting points in their methods worthy of attention. In the early years of railroading in America there was little signalling, except at the more important junctions and stations where mechanical signalling, similar to that in use in this country, was fitted. On the stretches of line between stations trains were operated under orders from the train despatcher and there was no block working as a rule, at least, not as we understand it here. The installation of signal boxes and mechanical signals was out of the question on the long lengths of single line that prevail there. Block working was sometimes carried out on the busier sections, near towns and on some of the great main lines, but, speaking generally, there was little or none on most railways. Eventually traffic increased and the need for proper security began to be felt and the required help was found in the automatic block system which has, in recent years, spread at an astonishing speed over the railways of America and, with its latest apparatus and refinements, affords a fine example of the power of a scientific signal system to afford safety under every condition of working and to promote the business and increase the capacity of a railway.

As they have had the advantage of beginning late and of being able to introduce the most up-to-date appliances without abolishing existing systems, virtually all the automatic signalling in America is worked and controlled by track circuiting, the general principle of which may be seen by reference to Fig. 1. At the commencement of the section of line concerned a signal, operated (say) by an electric motor, is placed. The rails are divided at the block point by insulated fishplates or joints, another pair being placed at the end of each section. Connected to the rails at the near end of the section is a relay, and at the far end some constant supply of power at low E.M.F. is connected in a similar way. The intermediate rail joints are bonded across by copper or iron wires, like the rails of a tramway. When no train is on the section the current will flow along the rails, as shown by the arrows in the figure, and energise the relay. The relay governs a local circuit controlling the signal motor and while the relay is energised the signal will stand at "clear." When a train enters the track circuit the relay will be shunted by the wheels and axles and so will open the signal circuit and put the signal "on." The signal will remain at danger until the train leaves the section, when it will come "off" upon the energising of the relay. This will indicate the principle of the auto-

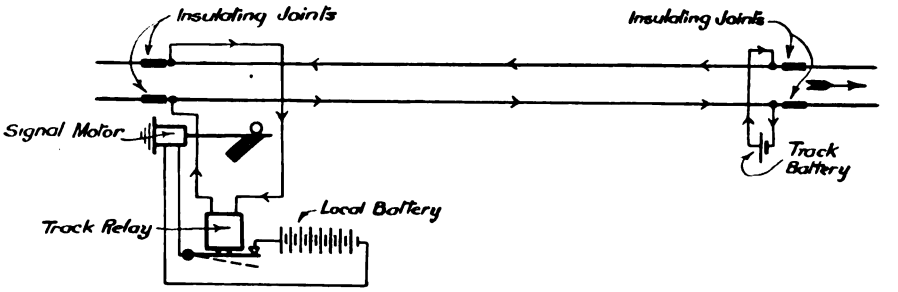

FIG. 1. DIAGRAM TO SHOW PRINCIPLE OF TRACK CIRCUIT SIGNALLING.

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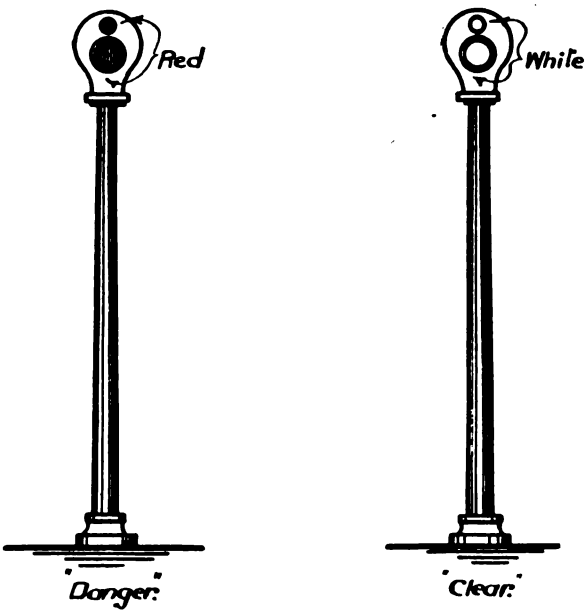

FIG. 2. EARLY AUTOMATIC DISC SIGNAL.

matic signal controlled by track circuit.

Variations of the arrangement are installed as circumstances require. Sometimes, when the block section is long, it is necessary to have several track-circuits acting as one. In fact, a great many conditions have to be taken into account when spacing out automatic signals on this plan: speed and weight of trains, their frequency, the gradients and curves, etc.

The earliest signals fitted up on this plan were, it would seem, the familiar Hall disc signals, of which there are still large numbers in use in America. Fig. 2 illustrates these. The mechanism is contained in the top case and moves a red disc, which is normally shown through the window to indicate "danger." When the signal is energised to indicate "line clear" the disc moves away and a white background shows. The night signals are given by lights above the disc as shown in the figure. These signals are very simple and reliable, but have the disadvantage of being colour signals both by day and night. A fall of snow may obscure the disc and make it difficult to see the indication.

As a rule, when there is no train in the section, the signal governing it stands at "clear" (called the "normal clear" system), but an arrangement is sometimes used so that, after a train has passed the signal, it stands at "danger" until required to be lowered for an approaching train, even though the section be clear. This is called the "normal danger" system and one big line in America works all its automatic signalling on this plan. It uses less power but requires a more complicated arrangement of circuits and is therefore more difficult to keep in order and to inspect. It conforms to the usual signal-box way of working in that the signals are only used when required. The "normal clear" method is used to a far greater extent and in some cases has been substituted for the "normal danger."

At first the only signals provided were those governing the entrance to a block section, but it became necessary to place distant (or caution) signals a certain distance from the home block signals to repeat the indications of the latter. In the case of the disc signals these showed green and white instead of red and white. It may be as well to refer here to the night indication and the

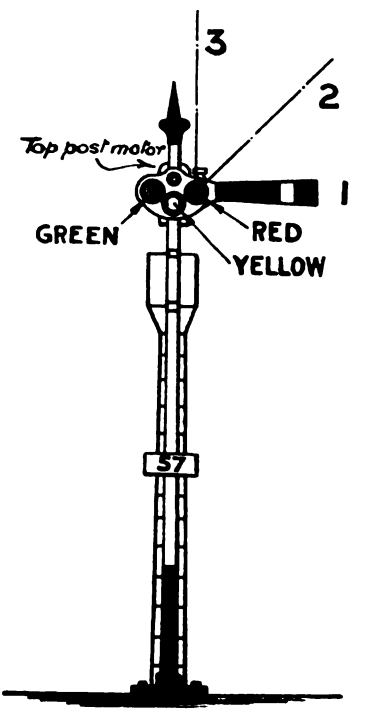

FIG. 3. "TOP-POST" MECHANISM SIGNAL.

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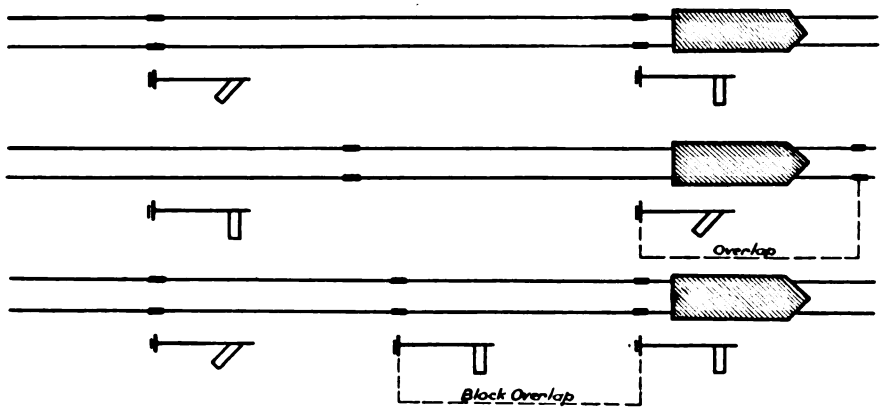

FIG 4. SYSTEMS OF SIGNAL CONTROL.

distant signal problem, both of which have received much attention in America. As in this country, red is the night indication for "stop" and white was largely used for "clear." The dangers of this practice are well known, and eventually many American lines adopted green in place of white. The distant signal was never treated the same as the home signal, as here. On lines using red and white for home signals, distant signals showed green and white. With the adoption of green for clear it became necessary to find a new colour for the "on" position of the distant signal, and yellow was adopted for this purpose. Red, yellow, green in the modern code represent "stop," "caution" and "proceed." (These colours are now used by the Electric Railways of London.) The Chicago and North Western Railway uses red and green side by side for "caution."

At the same time that the disc signal was

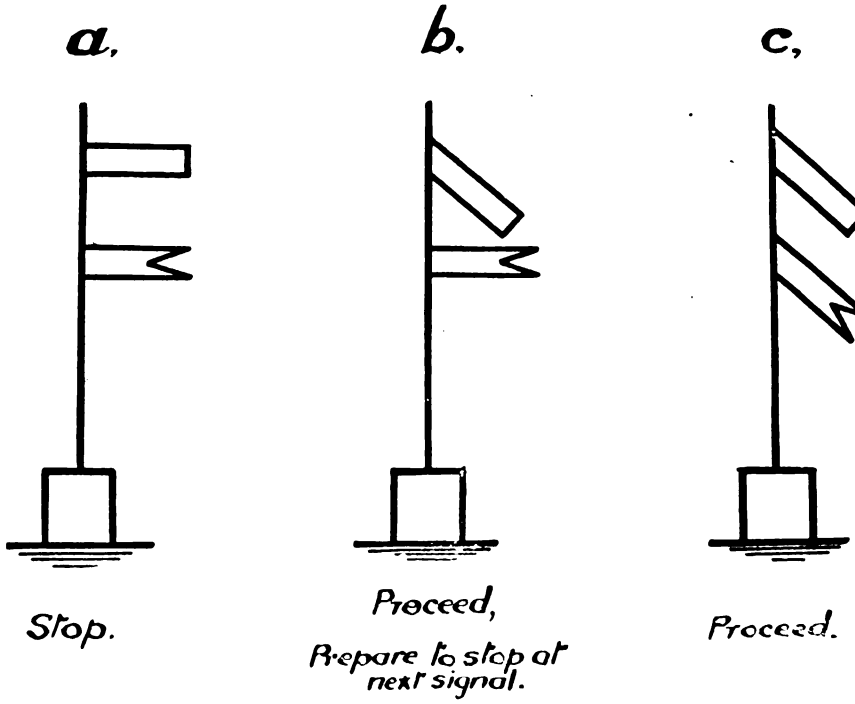

FIG. 5. AUTOMATIC "HOME" AND "DISTANT" SIGNALS.

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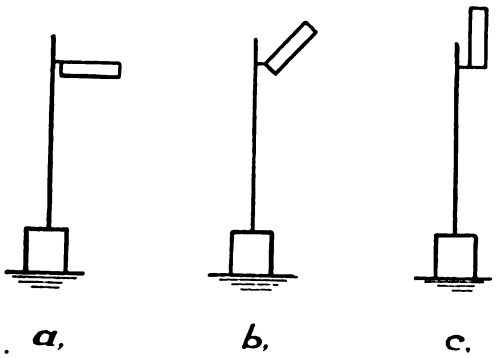

FIG. 6. AUTOMATIC THREE-POSITION SIGNAL.

evolved inventors turned their attention to working semaphore signals by various means. There were compressed air and gas signals and electric motor signals. For purely automatic working the latter are most suitable and have been brought to a high degree of perfection. There are several different makes in use—some having the mechanism at the base of the pole and others having it up at the top directly on the semaphore spindle. Fig. 3 illustrates a signal of the latter type. A signal of this description, but on the left hand side of the post, may now be seen outside Paddington station, Great Western Railway, as described in the January RAILWAY MAGAZINE.

For ordinary through working the usual principles of control are illustrated by Fig. 4. In the first example the block extends from one signal to the next exactly. This is a very general way but affords no safeguard against over-running signals. Sometimes what is called an overlap is provided and prevents one signal clearing until the train is a certain distance beyond the next. When traffic is very frequent the blocks are made very

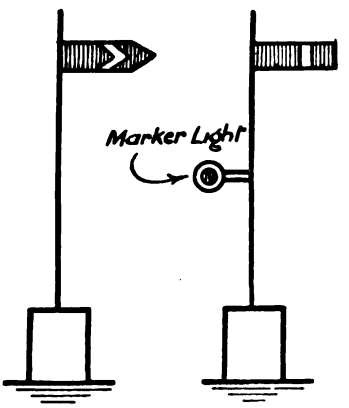

FIG. 8. DISTINCTION OF "BLOCK" SIGNAL.

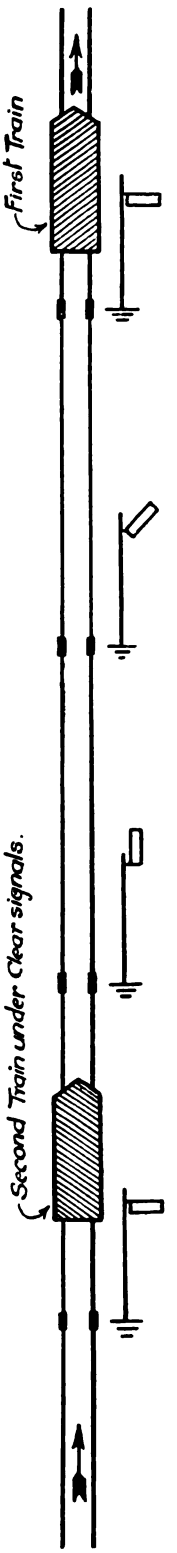

FIG. 7. DIAGRAM OF THREE-POSITION SIGNALLING.

short and a full block overlap is provided. These are also shown in the Figure. At first, in America, signals moved downwards and operated in two positions. This necessitated, with medium or short lengthed blocks, two arms to each signal —home and distant Fig. 5 shows the indications given by this system which is in extensive use. Later on a three-position system was evolved with the idea of making one arm serve for both home and distant indications. About the same time also it was proposed to make the arm move upwards to indicate "clear," as on the Continent, and these two ideas were combined and have found great favour.

Almost every new signal installation in America is on the three position, upper quadrant principle. Fig. 6 shows corresponding indications to that in Fig. 5 for this system. Red, yellow and green (or red, green and white lights) are used for the three positions of the arm. There are now many hundreds of miles of line signalled on this plan. In Fig. 7 can be seen the principle of working, with two trains running at the full speed distance from each other. When automatic signals are in use it sometimes occurs that a junction or crossing will come in the division and necessitate a signal box and men. It is usual in

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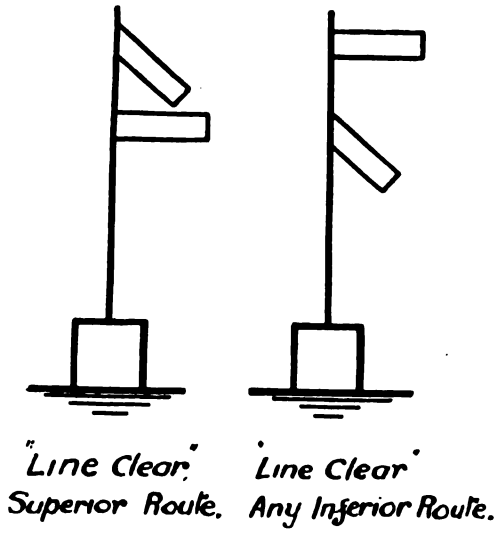

FIG. 9. ROUTE SIGNALLING.

such cases to carry the track circuiting right through the "Interlocking" (as it is called) and make it control the signals operated from it. Electric indicators are provided to announce the approach of trains to the signalman. In case of a failure of the automatic signals the rules generally allow a driver to proceed after waiting a certain specified time even though the signal remain at "danger." He is supposed to proceed at very slow speed, keeping a good look-out, and on some lines has to be preceded by a flagman. This is not allowed at signals that are worked or controlled from a box, and so a distinction is made between "Interlocking" and "Block" signals. Fig. 8 shows two ways used for this purpose—one by pointing the arm and the other by providing a marker light—of distinguishing the Block signal.

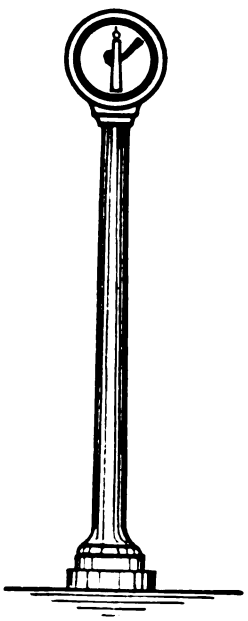

FIG. 10. SWITCH INDICATOR.

Here we may notice one or two interesting points about American "Interlockings." One thing that strikes the Britisher on seeing an American signal plan is the fewness of signals. As a rule there are no "advance" signals at all—only a home and distant signal. Then there is usually no attempt at signalling routes. The ordinary plan at a junction is to provide two arms on the home signal governing according to Fig. 9 however many routes there are. Sometimes ground or dwarf signals are used in place of the second arm. As converging trains are allowed to approach a junction together, trap points (or "derails" as Americans call them) are fitted to catch a train that should over-run the signals. These are not allowed in England on passenger lines, the requisite protection being obtained by the Block System.

Passing sidings and crossover roads occur in a section of automatic signalling at times, and these are usually worked by ground levers fitted with circuit controllers so that when the switch is opened the signals will be held at danger against approaching trains. To warn the trainmen of the presence of a train in the section and guard against their opening the switch indicators are provided similar to Fig. 10, which shows one of the upper quadrant semaphore type. As a rule, automatic signals are not placed to danger until the engine is passing or has passed the signal, but on one or two lines the arrangement illustrated in Fig. 11 is used. In this case the engineman sees the signal go to danger as he is approaching it, and it makes him into an examiner of the working. If he should find the signal against him, he has to stop at the block-marker—about 200 ft. from the signal—not go right up to the signal.

The working of points and signals by

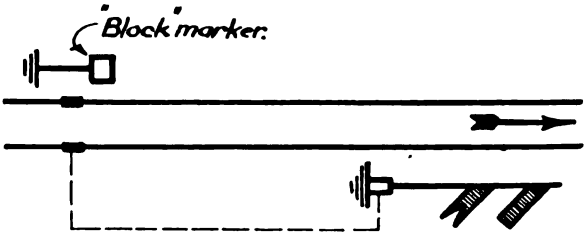

FIG. 11. PLACING SIGNAL TO "DANGER" IN ADVANCE OF ENGINE.

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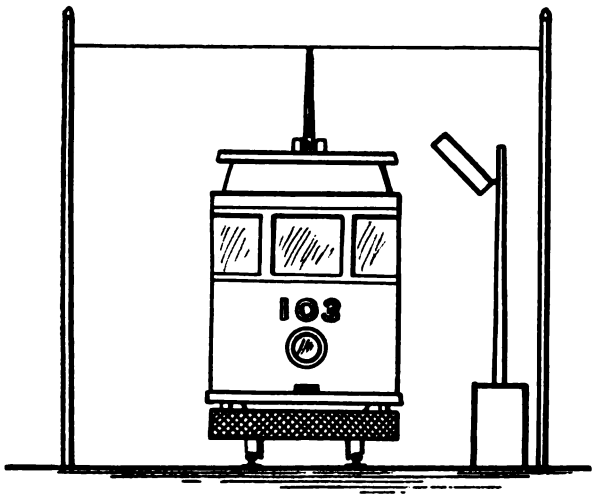

FIG. 12. LEFT-HANDED SIGNALLING FOR ELECTRIC RAILWAY.

power has assumed large proportions in America, the electro-pneumatic and all-electric systems being most adopted. Combined with track-circuit locking and automatic signal control, the installations at many of the large stations represent the highest skill of the signal engineer. Electric traction has developed extensively in America both for main and "inter-urban" lines, and several new features have come into signalling as a consequence. One of the most important is the use of alternating current for track circuiting and for operating signals. In applying the track-circuit to an ordinary electric railway the fact that the rails are ordinarily used for conveying the return current from the trains has to be taken into account.

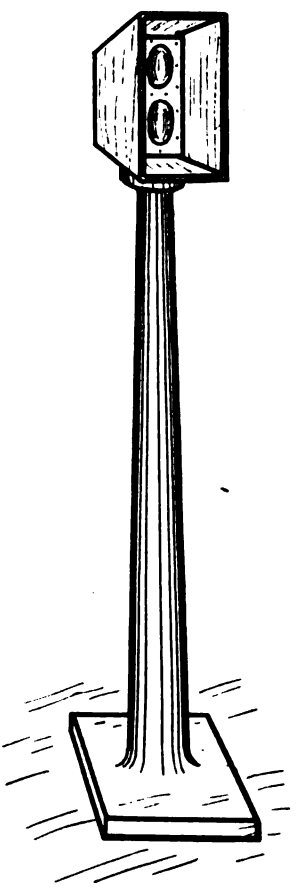

FIG. 13. LIGHT SIGNAL.

It will readily be seen that it might happen that the track-relay was energised by "false" current, though a train was in the block, with serious consequences. Ingenious apparatus has been designed to overcome this, but the most satisfactory solution of the difficulty has been found in alternating current. Track relays designed to work with alternating current will not respond to direct current, or to alternating current of other than a predetermined frequency if so desired. The rails can be made electrically continuous for direct current and be insulated into block sections for the alternating signal current by means of insulating joints bridged round by "impedance" bonds—bonds having little resistance, but large reactance. When there is a large section of line equipped with signals and there is plenty of power available, it is much more satisfactory to work them in this way than to have the trouble of batteries, with all their renewals and recharges and cleaning.

Many large installations of alternating current signalling have lately been erected. The fast inter-urban electric lines have also begun to adopt up-to-date signal apparatus. Most of these lines are worked on the overhead trolley system, and in order to allow

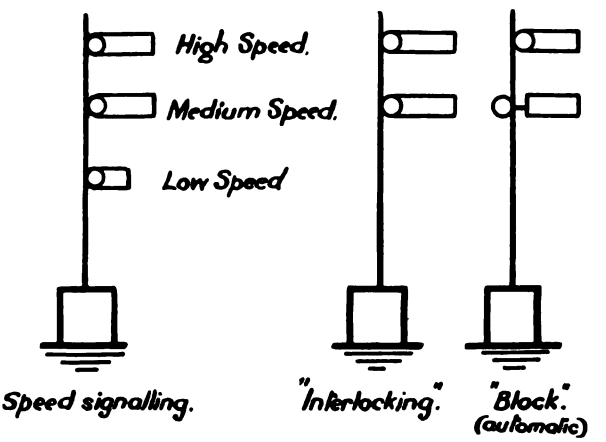

FIG. 14. NEW "SPEED" SIGNALLING.

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of a good view of the semaphore arm, it has become the practice to place it to the left of the post, as in England, shown in Fig. 12. The continuous row of poles would prevent it being seen if it was displayed in the usual American style. Automatic signalling on single lines has to be arranged on a rather different plan to that used for double lines, for opposing trains have to be prevented from getting between two passing places and yet following movements have to be allowed. This is sometimes called the "Absolute Permissive Block" system. A good deal of experimenting has taken place of late to see what can be done with light signals, that is, signals having lights both for day and night indications. Good results have been obtained with specially designed lenses and powerful lamps with hoods over them for contrast, after the manner of the sketch in Fig. 13. These signals have found favour on the electric lines.

It now remains to notice what has become a very prominent feature in American signalling, and that is the system of "speed" (instead of "route") signalling. Reference has already been made to the usual method of indicating routes, but in the new scheme no attempt is made to indicate routes at all. There are three speeds reckoned upon: normal (high), medium, and low. The standard signal has three arms, one for each speed, as shown in Fig. 14. Sometimes the low-speed arm is not provided; but there are nearly always two arms. At any rate, there are always two lights, a marker light being fixed in place of the second arm where "medium speed" is not required.

To distinguish between an interlocking and an automatic signal, the lights of the latter are "staggered" or placed out of line with each other. Fig. 15 shows the various indications given in this system. Each signal is capable of operating in three positions, so that each signal acts as a distant for the next one. Aspect *a* means "stop." When the line is clear for one block ahead the signal will assume aspect *b* ("proceed; prepare to stop at next signal"). At the same time the next signal in the rear will assume aspect *c* (being already at *b*): "pass next signal at limited speed." Aspect *d* is assumed when the next signal ahead shows *c*, and is the full-clear signal. Where the blocks are not short, aspect *c* is dispensed with and *d* follows *b*. Aspects *f* and *e*, and *h* and *g* are corresponding aspects for the medium and slow speed arms, only there is nothing to correspond to *c*.

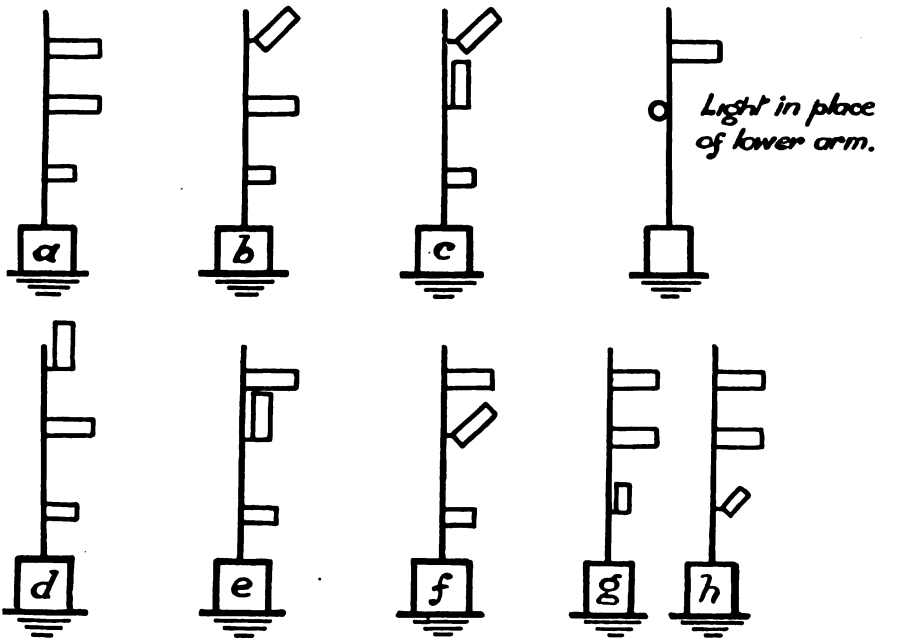

FIG. 15. SIGNAL "ASPECTS."

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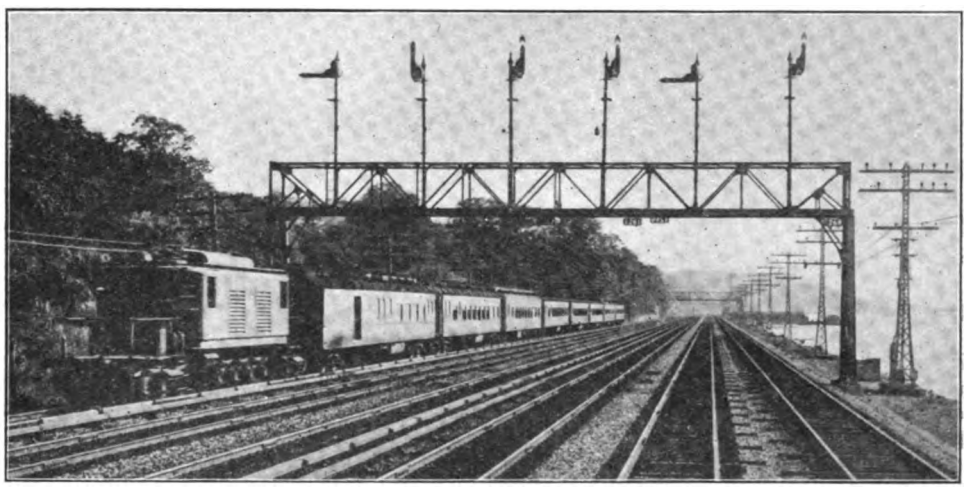
At interlockings the various indications are governed by the route set up by the signalman and by the condition of the track and position of next signal in advance. Such a system seems very peculiar to the English signal engineer, and is a complete reversal of policy from that pursued here. It would seem to be very successful where it has been adopted, however, although such a maze of arms and different coloured lights looks so difficult to arrange and understand.

There are many other interesting things in American signalling which it would take too much space to consider here. Able to profit by the old country's experience and having the advantage of beginning later with a new field and set of conditions, our cousins have been able to apply the very latest engineering knowledge at once and produce results not seen here—at least on the same scale. However, the safest place on earth is still a seat in a British railway train.

"The 20th Century Limited."

NEW YORK CENTRAL AND HUDSON RIVER RAILROAD.



A FINE view showing this world-famous train, on the electrically-operated section near New York. The line here is multi-track, four roads equipped for electric traction, and is laid with steel rails weighing 105 lbs. per yard. Traffic is controlled by automatic three position upper quadrant signals. As shown the train is passing along the bank of the Hudson River. The locomotive is one of the latest class.

This train is made up of steel vestibule cars, electrically lighted throughout, with Club car, standard and observation-compartment, sleeping and dining cars. In the observation car, telephonic connection is made with the city systems while the train is standing at the terminals at New York and Chicago. The services of a stenographer are available, free, in the observation car. The Club car is fitted with shower bath and hairdressing saloon, while in attendance on the train are a ladies' maid and a valet. Among other conveniences may be mentioned a free library, writing desks, stationery, the latest periodicals for the use of passengers, while a special feature is made of the posting of stock quotations, baseball scores, and the latest news, in the Club car. The total weight of the train, when made up of eight cars, is stated at 541 American tons, but this apparently includes the weight of the locomotive.

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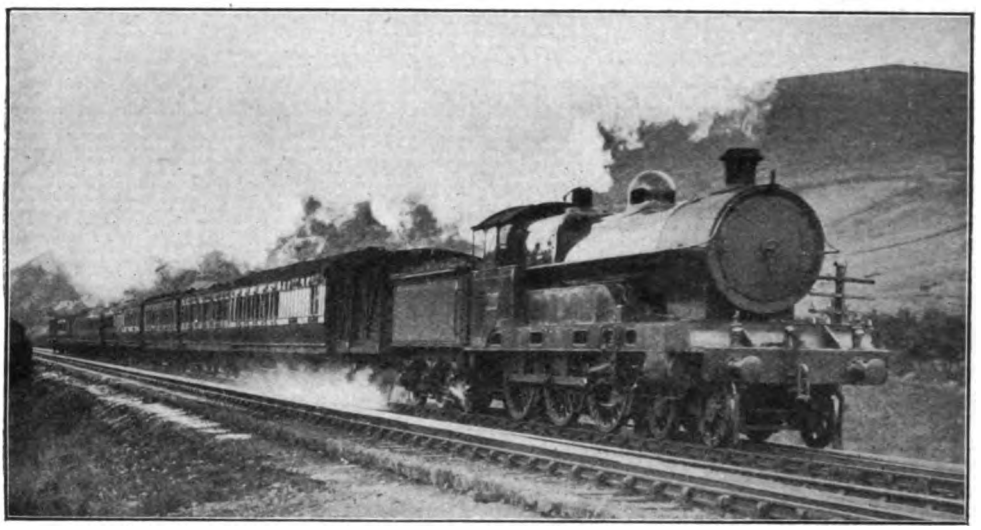

Photo] [*F. E. Mackay.*

LONDON AND NORTH WESTERN RAILWAY.

Carlisle-Windermere express, near Tebay, 4-6-0 locomotive No. 650 *Lord Rathmore.*

British Locomotive Practice and Performance.

By CECIL J. ALLEN.

BY an extraordinary coincidence—or, rather, chain of coincidences—almost every run that I have had upon an important express since writing the article that appeared in last month's issue has been subject in its early stages to delays of an abnormal character. The subsequent running on these journeys was of such interest, as bearing upon the subject of that article, that I will describe them forthwith, without further introduction.

Of all these delays, the most unusual was one which occurred between Birmingham and London, Great Western Railway, on the 4 p.m. two-hours' express *ex*-Snow Hill. The train was on time from Birmingham, having a modest load of 130 tons, with passengers and luggage, and headed by a 4-cylinder 4–6–0 engine of the "Knight" class. We were badly slacked past the widening works at Bordesley, and thus took 11 min. 10 sec. to pass Solihull, 7 miles, but the ensuing 10¼ miles to Hatton were covered smartly in 10 min. 10 sec. and the 6 miles on to Leamington stop in 6 min. 5 sec. This gave a total of 27 min. 25 sec. from Birmingham to Leamington, 23¼ miles, but only 25¼ min. net against 26 min. allowed. The maximum speed, between Warwick and Leamington, was 72·5 miles per hour. At Leamington four more 8-wheelers were added, bringing the load up to 240 tons, and we started for London 2 min. late. From Leamington to Southam Road there is a steep rise, commencing at 1 in 202 and finishing with 3¼ miles at 1 in 187; up this we went magnificently, attaining and maintaining a speed of 55·6 miles per hour. Just as we were nearing the top of the bank, however, the brakes were sharply applied, and on looking out of the window to ascertain the cause, I was astonished to see our ungallant "Knight" careering away with the leading coach, leaving us in the open country half-a-mile short of Southam Road Station. The engine was, of course, stopped at the station, but the principal difficulty lay in the fact that the whole weight of the train had been thrown upon the gangway connections between the two leading coaches, which were now unrecognisable. This was overcome in the end by detaching the coaches in question, but it was not until 47 min. after

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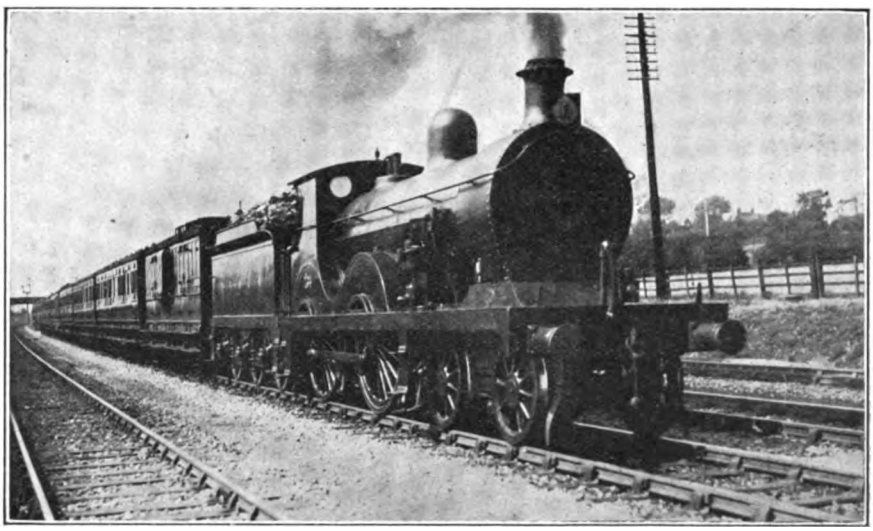
our sudden stop that we were once more on the way, with a reduced load of 175 tons. It says something for the uphill work from Leamington that our start-to-stop time for this short run, 5¾ miles long and all steeply uphill, was only 8¼ min.

After the brilliant start from Leamington some good work might now have been expected, especially with the load substantially reduced, but the performance was disappointing. We took 8 min. 5 sec. to pass Fenny Compton, 5 miles (mostly up at about 1 in 240), 9¼ min. thence to Banbury, 8½ miles, and 4 min. 50 sec. from Banbury to Aynho Junction, 5 miles. From here the engine that had breasted a continuous to Princes Risborough, 9¼ miles, was only 8 min. 55 sec., and from Risborough to West Wycombe, 6 miles, 5 min. 35 sec.! The last 2¼ miles to the regular High Wycombe stop made by this train occupied 3 min. 10 sec. Thus our start-to-stop time from Southam Road to High Wycombe, 54½ miles, was 58¼ min., but this time might, on the driver's own showing, have been improved on without difficulty. As a matter of fact the net time of 65 min. from Leamington to Wycombe showed a loss of 2 min. on schedule. From Wycombe we passed Beaconsfield, 4¾ miles, in 6¾ min., and Northolt Junction, 16½ miles, in 17 min. 5 sec., but were finally diverted *viâ* Ealing,



Photo] [*W. H. Kelland.*

SOUTH EASTERN AND CHATHAM RAILWAY.

No. 754 on second portion of afternoon Continental train, near Grove Park.

stretch of 1 in 187 at a minimum speed of 55·6 miles per hour with 240 tons behind the tender actually fell to 44·5 on the 1 in 200 of Ardley bank with a load of only 175 tons! So we took 6 min. 5 sec. for the 5¼ miles from Aynho Junction to Ardley, while 12 min. 20 sec. for the 13¼ miles from Ardley to Ashendon Junction was not a particularly smart time. From the last-mentioned point, however, much improved work was done. On the level past Haddenham we attained a speed of 68·1 miles per hour from Ashendon slack, and then ascended the steep Princes Risborough bank of 6 miles at 1 in 200–176–161 at a minimum speed of 56·3 miles per hour! Consequently our time from Ashendon and after further delays arrived 63 min. late.

As a contrast to this run I give one, timed a few days subsequently, on the Great Western 5.5 p.m. two-hours' express from Bristol to London. This train travels by the heavily graded Badminton route, and the time of 120 min. for the 117½ miles' journey leaves but little "delay" margin with a load of 300 tons, as we had on this occasion, composed of 5 70 ft. (including "diner") and 4 60 ft. eight-wheelers of the latest stock. The engine was a 2-cylinder 4–6–0 No. 2909, *Lady of Provence*, in charge of Driver Pocock, of Bristol shed. We started on time, but did only moderately on the 1 in

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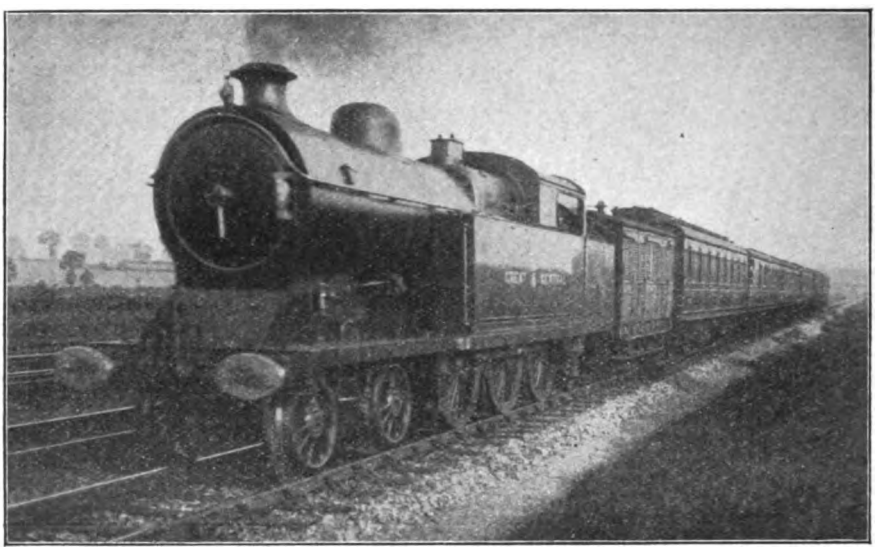
75 ascent to Filton Junction, as the speed fell to 21·4 miles per hour; we recovered well, however, on the further rise past Coalpit Heath, where a speed of 52·9 miles per hour was maintained, until we were checked and stopped by signal at Sodbury. Our time from Bristol to Filton, 4¾ miles, had been 10 min. 35 sec. and to Sodbury, 13 miles, 20 min. 35 sec. start-to-stop. It appeared that the "tell-tale" wire employed in this and other long tunnels on the Great Western system had by some means been broken, and it was not until this matter had been investigated that we were allowed to proceed, very slowly, to Badminton. We thus passed Badminton 33½ min. after leaving Bristol, this the speed rose rapidly to 69·2 miles per hour at Shrivenham, 72·5 at Uffington, and 75 at Challow, sustained with 300 tons for several miles on a grade averaging no steeper than 1 in 800. As the weather was still inclined to be misty in places, driver Pocock slackened to 50 miles per hour through Didcot station. Even thus our time from Swindon to Didcot, 24¼ miles, was only 21 min. 5 sec.; the fastest spurt was over the distance of 10 miles from Uffington to Steventon, covered in 8¼ min. Speed recovered from this check to 68·1 miles per hour at Pangbourne, but a very much worse slack was made at Reading, where this train takes the platform road to slip the rear coach.



Photo] [*H. E. Ambrose.*

GREAT CENTRAL RAILWAY.

Down Woodford train, 4-6-2 tank engine No. 168.

and as this distance is only 17½ miles, there was now no hope of keeping time. Indeed, the delay had cost us nearly 11 min., and in addition we were passing Badminton at less than half the usual speed. But Driver Pocock set out in magnificent style to show off the paces of his engine.

We touched a maximum of 80·3 miles per hour beyond Hullavington, but then ran into a very thick bank of fog, which enjoined a more cautious rate of speed for some distance, and a careful slack through Somerford. So the 17 miles from Badminton to Wootton Bassett, where we reduced speed as usual, took 17 min. 5 sec., and the 5¾ miles on to Swindon 6 min. 55 sec. After So the 17 miles from Didcot to Reading took as much as 18½ min. The running beyond Reading was, however, of the very first water, the speed at Twyford being 66 miles per hour, at Maidenhead 70·3, at Taplow 72·5, and from Slough onwards 75—all on a practically dead level track—until we were suddenly brought to a stand for signals at West Ealing. Our times were: from Reading to Twyford, 5 miles, 5½ min.; from Twyford to Slough, 12½ miles, 10 min. 35 sec.; and from Slough to Hanwell, 11¼ miles, 9¼ min. Finally we arrived in Paddington 135¾ min. after leaving Bristol, the two chief delays —Sodbury and Hanwell—exactly accounting for the loss of 15¾ min.

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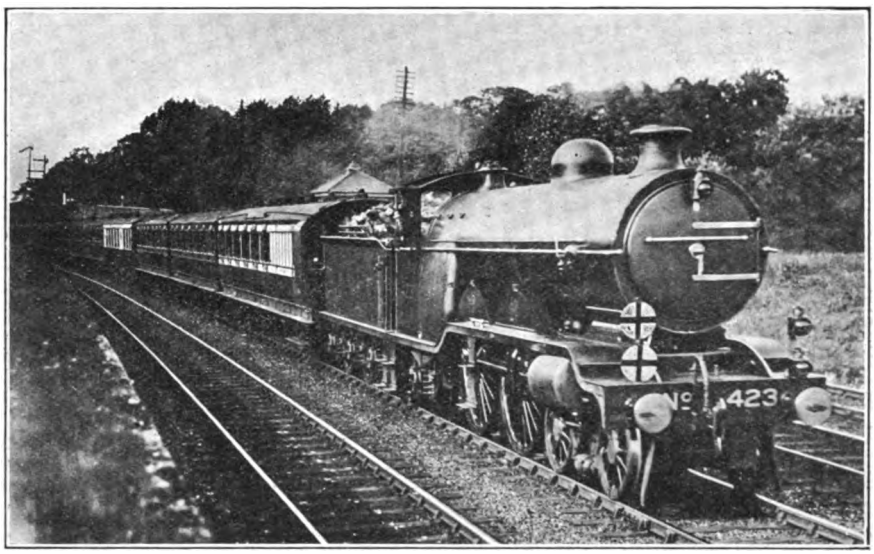
But there were also the fog delays, which seriously affected the total time. Strictly speaking, as neither at Little Somerford, Didcot or Reading were there signals against the train, the driver checking mainly because of the banks of mist run through at these points, it might not be considered legitimate to allow for these delays, but it is not possible otherwise to appreciate the excellence of the running. Allowing for normal speed in all these instances, inclusive of a reduced speed through the platform road at Reading, our net time from Bristol to London was 116½ min.; with full speed through Reading, as in the case of the 12 noon train *ex*-Bristol, this would have been



Photo] [*F. E. Mackay.*

LONDON, BRIGHTON AND SOUTH COAST RAILWAY.

3.20 p.m. Victoria-Eastbourne express, 4–4–2 superheater locomotive No. 423.

114½ min. for the 117½ miles. Our *actual* time from Badminton (passed very slowly) to London, 100 miles—inclusive of all delays—was only 102¼ min., but the net time from this point is most difficult to estimate. The booked time is 96 min. As an example of the wonderful work performed, the time for the 87 miles between passing Hullavington and Hanwell may be mentioned. This was actually 82 min. 10 sec., *inclusive of all delays*, which is equivalent to a fraction less than 77 min. with no checks at Somerford, Didcot and Reading. From Swindon to London, with checks at Didcot and Reading and a dead stand at West Ealing, our total time was 78¼ min. for the 77¼ miles—70¾ min. net with the normal slack at Reading, and 68¾ min. net with no checks. This is by no means an isolated instance of driver Pocock's prowess, as I have received from a correspondent details of another run of equal merit behind the same engine in the reverse direction, which will be given publicity at the earliest opportunity.

My next similar experience occurred on the Great Eastern Railway. The train in this instance was the 3.10 p.m. express from Liverpool Street to Ipswich—one of the new trains on the crack 84-min. schedule—and the engine a 4–6–0 superheater, No. 1520, in charge of driver Fish, of Norwich. There was not an exceptional load, the well-filled train of nine corridor 8-wheelers and three 6-wheelers aggregating 290 tons behind the tender. A good start was made, Bethnal Green being passed in 3½ min., but a bad signal check was experienced at Coborn Road. After slacking through Stratford the brakes refused to lift, and, despite gallant efforts on the part of No. 1520, the pace became more and more funereal until the driver gave up the unequal task and stopped the train at Gidea Park for the matter to be remedied. Then a splendid effort was made to regain the arrears. On 1½ miles of level track the speed rose to 43·7 miles per hour, and we then went right up Brentwood Bank without the speed falling below 30·4 miles

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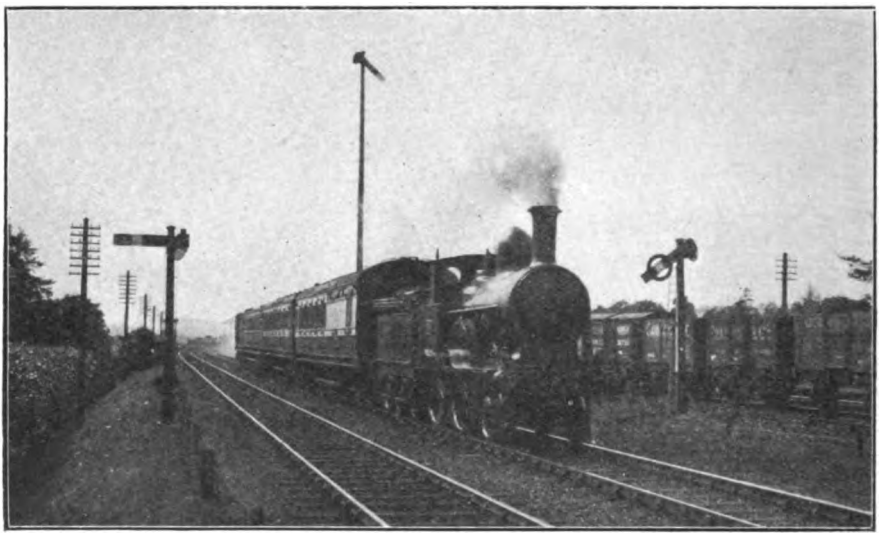
per hour. Indeed, the time from Gidea Park to Ingrave, 5¾ miles (of which 4¼ are adverse and inclusive of 3 at 1 in 84 average), was only 10½ min. Shenfield was passed 9 min. behind time.

From Shenfield to Chelmsford, 9½ miles, we took 9 min. 5 sec., with a maximum speed of 68·1 miles per hour at Margaretting; and from Chelmsford to Witham, 8⅞ miles, the time was 8 min. 55 sec., speed rising to 67 miles per hour at the last-mentioned point. On the short ascent to Hill House Box the rate did not go below 52·3 miles per hour, and we had again touched 65·2 at Lexden when we were slacked badly by signal approaching Colchester. Thus the 13 miles from Witham to Colchester took 13 min 25 sec., but the net time was only 13 min., making a total of 31 min. for the 31½ miles from Shenfield—4 min. inside schedule time. The slow rate through Colchester affected the climb to Ardleigh, and we thus took 9 min. 55 sec. for the 7¾ miles from Colchester to Manningtree. A maximum speed of 67 miles per hour was attained at Manningtree, and we then went magnificently up Bentley Bank, speed not falling below 46·9 miles per hour, while the time for the 5⅝ miles from Manningtree up to Belstead Box was only 6 min. 10 sec. Unluckily, a long permanent way check at Halifax Junction further spoiled the finish of the run, the time from Colchester to Ipswich, 17 miles, being 21 min. 25 sec. But even then, with both checks, driver Fish had covered the 48½ miles from Shenfield to Ipswich in 52 min. 50 sec., while the net time for this distance was probably under 50 min. I was only sorry to be unable to proceed with the same train to Norwich, as I am confident that the same praiseworthy effort to regain the arrears of time would have been continued to the end of the run.

The next run of the "series" was one on the North Eastern Railway from Leeds to Stockton. Owing to the derailment of a London and North Western train outside Leeds New Station, all access to that station from the west was cut off, and the London and North Western trains were diverted to the Central Station. To the latter, therefore, I wended my unaccustomed way in order to catch the 4.30 p.m. express for Newcastle, which is a through train from Liverpool. The load was one of nine mixed 8-wheelers, in all 235 tons, and the engine a 3-cylinder "Atlantic," of Class Z, No. 721, which is now superheater equipped. We left Leeds 20 min. late, but owing to the very cautious rate of speed round the connecting curve at Holbeck, and to signal checks at Pannal, Crimple Junction and outside Harrogate, we were unable to gain time on the first section of the run. But from Harrogate, although the running was not brilliant, we



Photo] [*E. A. Gurney-Smith.*

LONDON AND NORTH WESTERN RAILWAY.

Up Central Wales express, passing Harrow, hauled by a locomotive of the "Precedent" class.

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did very well. Despite a momentary check for signals at Nidd Bridge, Ripon, 11½ miles, was passed in 13 min. 55 sec., at 67 miles per hour. This was, however, the least enterprising part of the run, as the grades, including 2 miles down at 1 in 66 and 4 at 1 in 131, are exceptionally favourable. But we covered the 13¾ undulating miles from Ripon to Northallerton Low Gates in 14½ min., and the ensuing 5¾ miles up to Welbury, including a slight check at Northallerton Low Junction, in 7 min. 50 sec.; the minimum speed on the 1 in 200 ascent was 44·1 miles per hour. Beyond Welbury we ran cautiously, slacking at Picton Junction, not exceeding 64·3 miles per hour on the 1 in 170 descent to Yarm, and reducing speed very carefully through Eaglescliffe. But we covered the 8¾ miles from Welbury to Eaglescliffe in 9 min. 50 sec., and the last 3¼ miles into Stockton in 5 min. 25 sec., making our total time for the 43 miles from Harrogate 51½ min., or 51 min. net. The booking of 56 min. is certainly an easy one, but the driver's economy of 5 min. on it was the more creditable in view of the extreme moderation of his downhill running and the cautious speeds through the various junctions.

I have yet another recent run to add to this collection. On this occasion I was travelling by the 2.15 p.m. Great Central express from Manchester to Marylebone, when we were stopped unexpectedly at Woodhead owing to some wagons having broken loose from the preceding train in the tunnel. It may be news to some to know that Woodhead Tunnel is properly equipped with electrical instruments for single-line working, owing to the work now being carried out in connection with the ventilation scheme, and this working is put into operation every Sunday, including even the use of temporary facing-point connections to running roads at each end of the tunnel. Consequently on this occasion single-line working was immediately put into force, and we ran through the tunnel on the down line to Dunford Bridge, having only suffered a delay of some 12 min.—astonishingly little, I should imagine, considering the nature of the mishap. As a result of exceedingly good work on the part of the drivers concerned, this being a train of considerable weight and exceptionally tight timing, over 6 min. of the arrears were regained between Penistone and London. I will not describe this run now, however, as I have recently made a series of trips on this train, which I wish to tabulate and deal with at an early opportunity. To these runs may be added the London and North Western Railway journey from Liverpool to Leeds detailed in the last issue, when, owing to the buffer-locking of coaches outside Lime Street Station, the start was delayed 40 min., after which the driver applied himself to the arrears of time with such effect as to have a net gain of 15 min. to the credit of his engine on arrival at Leeds.

It is a most extraordinary coincidence that I should have had this sequence of abnormally delayed runs within the last four weeks (excepting the one last-mentioned), or since writing the article that appeared in the March issue. In every case a serious delay occurred at the commencement of the run from causes altogether outside the driver's control, and yet in every instance but one painstaking efforts were made on the footplate to regain the lost time. Unfortunately, on certain of the runs, signal or permanent way delays rendered these efforts somewhat ineffective, but it is greatly to the credit of drivers concerned that they did not on that account relax their attempts to reduce the arrears. I think this is characteristic of the majority of drivers. Indeed, so far as the regaining of lost time is concerned, I am convinced that it is more a practice of individual men than a tradition of individual companies, although it is certainly the case that some companies encourage the habit more than others.

Abnormal conditions of loading, however, constitute another question altogether. In this case the keeping or losing of time are matters which do not rest altogether with the driver concerned, as other factors must be considered. In the first place there is the question of water supply. This is a real difficulty on lines such as the Great Northern and London and South Western Railways, whose track water troughs are either widely separated or else non-existent. For instance, down Great Northern expresses leaving King's Cross have a heavily graded distance of some 80 miles to traverse before they reach the first troughs at Werrington, beyond Peterborough, and an extra heavy consumption of water in an effort to keep time with an express of abnormal weight out to, say, Hatfield may necessitate a special stop to replenish the water tank before these troughs are reached. The provision of troughs at Tempsford has been proposed, while another way of meeting the difficulty might be the use of tenders of

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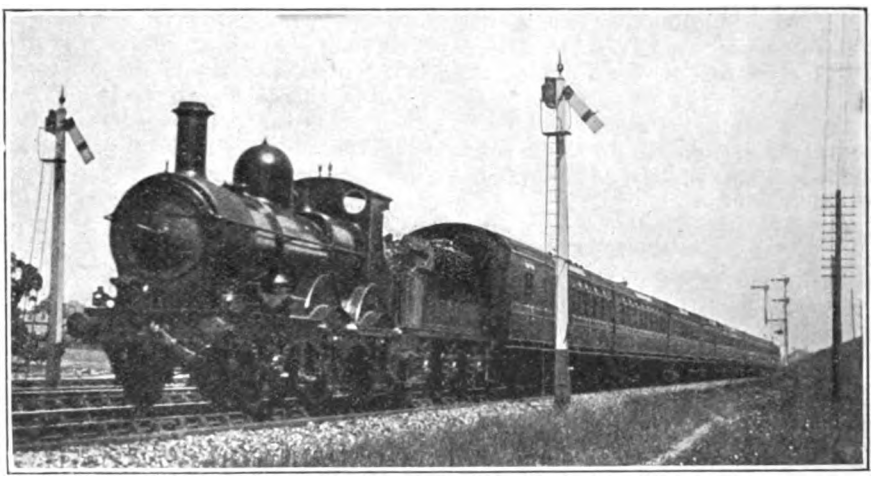
somewhat more ample water-carrying capacity, but meanwhile this difficulty is a very real one to drivers between London and Peterborough. Similar conditions prevail on the 108 miles' run of the non-stop Bournemouth expresses of the London and South Western Railway, especially on the up journey, in breasting the long rise past Winchester. Then again, it is impossible to consider the question of load apart from that of grading. For example, the haulage of 400 tons from Euston to Crewe, with a vertical rise of 950 ft. on the journey, is a vastly different proposition to the working of an equal load at the same average speed from, say, Marylebone to Sheffield, in which case the rise is as much as 2,137 ft. But this aspect of the question rightly belongs to the subject of hill-climbing, which we shall consider in the next issue.

Generally speaking, drivers exhibit the same characteristics in tackling abnormal loads as they do in attempting to make good abnormal delays. Moreover, the railways on which the most consistent efforts are made to regain lost time are usually the lines on which the heaviest loads are worked unpiloted with adherence to schedule times. To illustrate this I may quote, as an addition to my own experiences previously described, three runs sent me recently by different correspondents, on each of which the load hauled would certainly merit the qualification of "abnormal." The three lines represented are also, I think it might be said without fear of contradiction, the three on which the heaviest single-headed express trains are regularly to be found. These are the Great Western, London and North Western and Great Eastern Railways. On the Great Western Railway these loads are confined, almost entirely, to the summer months; on the Great Eastern Railway the same is the case, with the exception of certain of the winter restaurant car expresses on the Colchester line, which are regularly made up to tremendous lengths; on the London and North Western Railway, however, there are quite a number of all-the-year-round expresses that always load to 400 tons and over. The Great Northern Railway is often mentioned as a line of very heavy loads, but, so far as my own experience goes, the average loading of the principal Great Northern expresses does not come up to those of the London and North Western Railway, neither does their summer loading approach the summer service averages on the Great Eastern and Great Western Railways.



Photo] [*Rev. A. H. Starey.*

GREAT WESTERN RAILWAY.

12.25 p.m. Paddington-Westbury train, 2-4-0 locomotive No. 3210.

I will take first a run on the Great Eastern Railway, in which the "crack" summer train—the "Norfolk Coast Express"—had a load of no less than fourteen 8-wheeled corridor coaches and one 12-wheeled restaurant car. This train of 62 axles aggregated 406 tons empty, and not less than 425–430 tons with passengers and luggage; the engine was a 4-6-0 superheater — No. 1516. Unfortunately my correspondent's

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log is rather devoid of details; it would have been particularly interesting to have known the maximum and minimum speeds over this difficult road. The first 7¼ miles to Wroxham (mostly favourable, with the exception of the actual start) were smartly covered in 9 min. 50 sec.; the ensuing 8¾ miles to Trowse, with the long and severe slacks at Whitlingham, Wensum curve, and over the swing-bridge, occupied 13 min. 5 sec. From Trowse to Tivetshall the 13½ miles' ascent was compassed in 19¼ min., the engine having thus gained 50 sec. from the start on the most difficult part of the whole up journey. Despite a permanent way check at Haughley, the time for the 31¾ miles from Tivetshall to Ipswich was only 32 min. 40 sec. Beyond this point the work must have been simply magnificent, as the time from Ipswich (passed at reduced speed) to Colchester—17 miles of difficult grades—was only 21 min. 10 sec., and from Colchester to Witham, 13⅛ miles, 14¼ min. By this time, inclusive of the Haughley check, 2¾ min. had been gained. Unfortunately, however, the train was stopped dead by signal at New Hall Box (32 mile-post) for over 2 min.; even then the time from Chelmsford up to Shenfield, 9½ miles, was only 11 min. 35 sec., and from Shenfield to Chadwell Heath, 10¼ miles, 9 min. 55 sec. But any chance of keeping time was effectually and finally disposed of by a string of checks from Forest Gate right on to Liverpool Street; otherwise this would probably have been done without difficulty, even inclusive of check and stop. The net time on this remarkable run could not have exceeded 154 min. from North Walsham to London, 130 miles, or 5 min. under schedule.

Next I have a run on the London and North Western Railway, on which a two-cylinder 4–6–0 superheater engine of the "Prince of Wales" type had to tackle a load of no less than 450 tons *empty* from Rugby to London. My second correspondent does not mention the composition of the train or the amount of passengers and luggage conveyed, but, assuming the usual 5 per cent., we may take the total load behind the tender as at least 470 tons. The engine was No. 1704, *Conqueror*, which slipped badly at the start, on account of the greasy state of the rails. Consequently it took 12 min. to pass Welton, 7¼ miles, but the 5¾ miles thence to Weedon were covered in 5 min. 25 sec., and the 6¾ miles on to Blisworth in 6¾ min. The 3 miles from Blisworth up to Roade occupied 3 min. 10 sec. Some exceedingly fine work was now performed, the 7⅜ miles from Roade down to Wolverton being covered in 6 min. 55 sec., the 5¾ miles on to Bletchley in 5 min. 50 sec., and the 6½ miles from Bletchley to Leighton in 6 min. 35 sec. The rising grades from Leighton to Tring, 8½ miles, mostly at 1 in 330, were covered in 9 min. 35 sec., which gave the extraordinary time (with this load) of 16 min. 10 sec. for the 15 miles—entirely adverse—from Bletchley to Tring summit. No excessive speed marked the remainder of the journey, the time from Tring to Watford, 14⅛ miles, being 13 min. 5 sec., and from Watford to Willesden stop, 12 miles, 12 min. exactly. The total time from Rugby to Willesden, therefore, was only 81 min. 20 sec. One might consider 83 min. a fairly sharp booking for the 77½ miles' journey with any load at all heavy, but to gain over 1½ min. on this schedule with 470 tons behind the tender was a wonderful achievement for an engine of such moderate dimensions.

I have reserved for the conclusion of the article a most exceptional run, under similar conditions, on the "Riviera Limited" express of the Great Western Railway, for details of which I am indebted to a third observer. This was a midsummer journey, so that the Westbury and Taunton slip portions were not attached to the train, but despite this its total empty weight aggregated 441 tons, which all, of course, went through to Exeter, where two vehicles were slipped. The engine was one of the new 4-cylinder 4–6–0's of the "Prince" class, with 15 in. cylinders—No. 4045, *Prince John*. With a heavy load of passengers and luggage the load behind the tender totalled not less than 465 tons. Starting exceedingly well, *Prince John* passed Southall, 9⅛ miles, in 13 min. 39 sec.; Slough, 17½ miles, in 22 min. 38 sec.; and Reading, 36 miles, in 38 min. 40 sec. The mile-a-minute rate was attained at mile-post 11; from posts 17 to 19 (past Slough) a maximum rate of 67·1 miles per hour was maintained, while the average speed from posts 19 to 35 was as high as 66·1 miles per hour, on a virtually level track. A careful slack was made at Reading West Junction. A speed of 60 miles per hour was not reached on the rising grades from Reading to Newbury, but these 17⅛ miles were covered in 19 min. 1 sec. On the increasingly steep ascent to Savernake, culminating in 3 miles at 1 in 180–144, the speed fell to 42·4 miles per hour, but for all that the time for the 17 miles from Newbury

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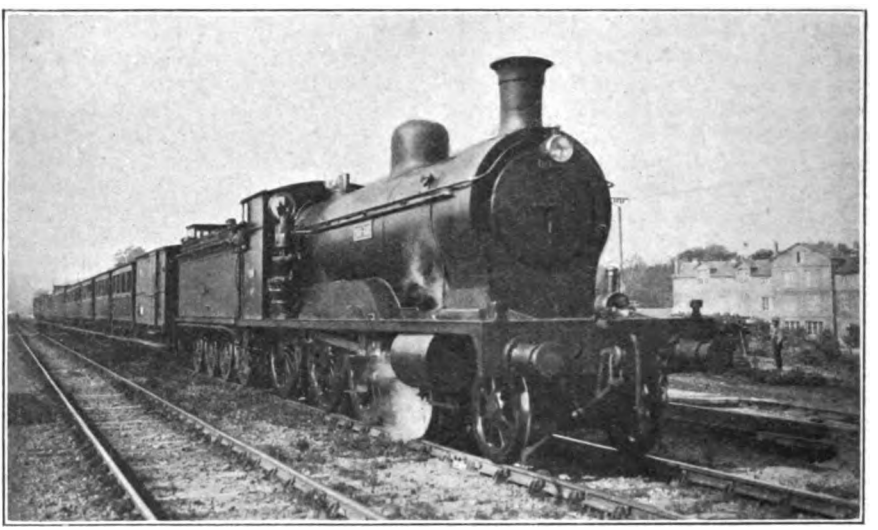
to Savernake was only 18 min. 42 sec. With so huge a load the time of 37 min. 43 sec. for the 34⅛ miles from Reading to Savernake, with adverse grades throughout, was very fine. 55¼ miles were covered in the first hour from Paddington, inclusive of the slack at Reading.

Continuing from Savernake, good use was made of the falling grades to Westbury, the 25½ miles being covered in 21 min. 54 sec., at an average speed of 69·7 miles per hour. The maximum speed was 80·3 miles per hour between posts 87 and 88, while an average of 76·7 was maintained over the 12 miles between posts 82 and 94. Westbury, 95⅝ miles from London, was passed (at the usual much reduced speed) 98 min. 17 sec. after leaving London, while an even more careful slack was made at Frome. The 13 miles from Westbury to the summit at "mile-post 122¾"—again almost entirely adverse, and culminating in a steep, though short climb at 1 in 107—occupied 18 min. 6 sec., inclusive of the Frome slack; the minimum speed on the 1 in 107 was 39·4 miles per hour. Fast running followed on the descent to Castle Cary, the 6¾ miles from the summit to the latter station taking 5 min. 54 sec., with a maximum speed of 79·6 miles per hour. The same high speed was continued over the favourable grades beyond, the 22½ miles from Castle Cary to Cogload Junction being covered in 18 min. 53 sec. Consequently the average speed from "mile-post 122¾" summit to Cogload Junction works out at 70·9 miles per hour, the 29¼ miles being covered in 24 min. 47 sec. The 5 miles from Cogload to Taunton consumed 4 min. 38 sec. Time was thus well in hand, *Prince John* having succeeded in covering the 142⅞ miles from London to Taunton in 145 min. 48 sec. from the start.

Perhaps the most brilliant running of the whole journey occurred in the ascent of Wellington Bank, and of this my friend has given very complete details. From mile-posts 162 to 174 the principal grades are as follows:—the mile ending at mile-post 163, 1 in 255 (Taunton Station is ¼-mile beyond this point); to mile-post 164, 1 in 330; to 165, practically level; to 166, 1 in 330; to 167, 1 in 209; to 168, 1 in 220; to 169, 1 in 167; to 170, 1 in 163; to 170½, practically level, on which stands Wellington Station; to 171, 1 in 220–103; to 172, 1 in 90; to 173, 1 in 81; to the 174 mile-post (Whiteball Summit), 1 in 126, easing slightly in the last ¼-mile. The actual speeds ever each of these miles were:—to mile-post 163, 63·4 miles per hour; to 164, 61·6; to 165 (the level mile), 62·1; and to 166, 62·5. This was the last mile covered at the mile-a-minute rate or over. The mile ending at mile-post 167 was covered at 59·6 miles per



Photo] [*W. H. Kelland.*

OUEST-ETAT RAILWAY, FRANCE.

4-6-0 locomotive (Highland Railway type, built in Glasgow) No. 230-335, on slow train near Poissy.

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hour; to 168, 57·7 miles per hour; to 169, 54·2; to 170, 52·3; and to 171, 51·0 miles per hour. In this way the speed exceeded 50 miles per hour until after Wellington Station had been passed, but thereafter, and very naturally, it fell rapidly. The mile ending at mile-post 172 was covered at 42·5 miles per hour; the next mile at 32·8; and the last mile to Whiteball Summit at 26·5 miles per hour. On entering the tunnel the rate had not fallen below 29·8 miles per hour, but owing to greasy rails it fell further before Whiteball Box was passed; the actual minimum speed my correspondent was unable to observe. In any case, however, the haulage, unpiloted, of a 470-ton train load from Taunton up to Whiteball, 10⅞ miles, in 12¾ min., was a really phenomenal achievement.

On the descent to Exeter speed was maintained for 10 miles at 75 miles per hour, and the 20 miles were thus covered smartly in 18 min. 8 sec. This gave a total time of 177 min. 41 sec. for the 173¾ miles from London, while the average speed from Southall to Exeter had been actually 60·2 miles per hour throughout. The train was slackened carefully through Exeter, and two coaches were slipped, leaving 395 tons to go forward. Of course it was a sheer impossibility for such a load as this to be worked unpiloted over the mountainous gradients of the South Devon line, and a stop was therefore made at Newton Abbot for a pilot. The 20 miles from Exeter to the stop opposite mile-post 214 were covered smartly in 22 min. 50 sec., giving a start-to-stop journey time of 200 min. 31 sec. for the 193¾ miles from London, at an inclusive average speed of 57·9 miles per hour. An engine of the 5 ft. 8 in. 4–4–0 "Duke" class came on as pilot, and, after a stop of only 2 min. 13 sec. duration, the run of 32 miles to North Road was completed in 42 min. 52 sec. Plymouth therefore was reached in 245 min. 36 sec. from Paddington, nearly 1½ min. before time, although 2¼ min. of the journey time had been spent in standing at Newton Abbot. Further than this, an engine of the 5 ft. 8 in. 2–6–0 class (of whose excellent work this is not the only record that I have received from correspondents) came on at North Road, and worked the load of 395 tons forward without assistance, gaining 3 min. 10 sec. on the schedule time of 81 min. for the 53½ miles of difficult grades on to Truro.

As regards the more noteworthy portion of the run—from Paddington to Newton Abbot—it would be difficult to cite a more meritorious example of keeping, and even improving on time with a train-load which, it is safe to say, could never have been foreseen when this schedule was first framed. Certain drivers would not have attempted to keep time under such abnormal conditions, but, as my friend aptly remarks in his letter: "The driver was clearly a sportsman. To my thinking, the personal element has a very large share in most runs." This is undoubtedly the case, and it is probable that the individuality of the driver will furnish the solution to many, if not most, of the problems and anomalies of locomotive performance.

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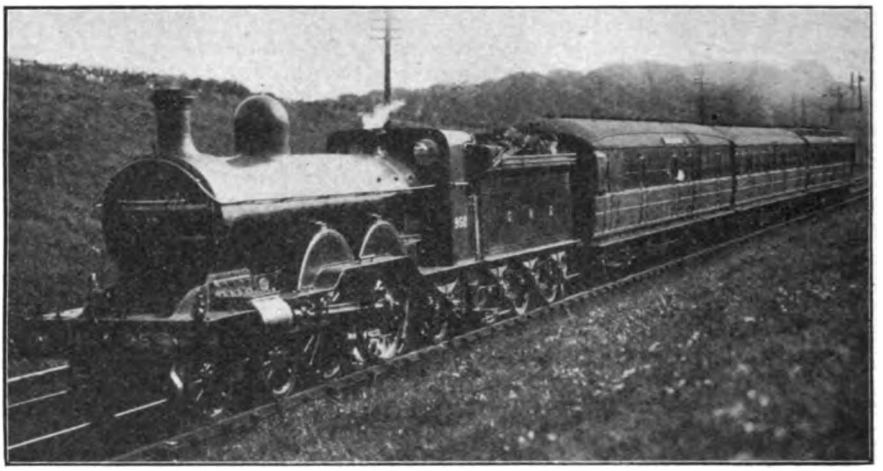

Photo] [*F. E. Mackay.*

GREAT NORTHERN RAILWAY.

Down Sheffield Express. Small 4–4–2 locomotive No. 950.

The Livery of Our Railways.

By A. E. JERDON.

WHAT may be termed the "Livery" of our railways, *i.e.*, the colour of the passenger rolling stock and engines is a subject of sufficient interest to warrant the preparation of comparative tables showing the proportion in which various colours or combination of colours are utilised on our railway systems.

Most people who travel have a more or less correct idea of the general appearance of the trains they use, and, less frequently, of the engines which draw them, but the appearance, say, of a Taff Vale carriage at Leeds, or a Somerset and Dorset engine at Crewe, would call for no remark, if indeed it were not altogether unrecognised.

It seems a fair method of computation to consider the "livery" of the various railways in relation to their milage, and for that purpose the actual mileage—the total owned, leased, or worked, and the proportion of all joint lines—of 37 railways has been taken, together with five joint lines which have rolling stock and engines of their own:—5 in Scotland, 6 in Ireland, 2 in the Isle of Wight and the rest in England, aggregating in all 22,610 miles. Electric lines, narrow gauge light railways, and also a few small standard gauge lines have not been included.

The distinctive livery of passenger rolling stock and engines appears to divide itself into five main groups in each case, although it is a matter of some little difficulty to determine in just which group that certain lines should be included; thus it might be contended that Lancashire and Yorkshire carriages should find a place in group 3 rather than in 5, and that those of the Dublin and South Eastern should be in group 2 instead of 1. Exception may also be taken by some readers to the nomenclature of certain colours, but when even official descriptions vary on these points some freedom must be allowed the mere railwayist, and the writer has done his best both from personal observation and reference to reliable authorities, to give correct information.

The proportion of those joint lines having their own carriages or engines, or both, differing in colour from that of one or more of the owning or working companies, has been deducted from these. In the case of the Portpatrick and Wigtownshire Joint Line, the proportions are so relatively small, that each of the four leasing companies has been allowed to retain its share, although strictly speaking the two Scottish companies should have divided the total mileage between

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TABLE I.—PASSENGER ROLLING STOCK.

Colour.	Miles.	Percentage of Total.	Railway.
1. Shades of brown (chocolate, maroon, umber, etc.) ..	6,213	27½	11 Railways. Great Western: Dark red-brown. Great Southern and Western: Purple-brown. South Eastern and Chatham: Maroon. Midland Great Western: Dark brown. London, Brighton and South Coast: Umber. Dublin and South Eastern: Red-brown. Belfast and County Down: Maroon. Rhymney: Dark chocolate. Barry: Red-brown. Brecon and Merthyr: Dark chocolate. Wirral: Dark chocolate.
2. Crimson lake and dark red	5,891	26	7 Railways. Midland, North Eastern, North British, Glasgow and South Western, North Staffordshire, Midland and South Western Junction, Stratford-upon-Avon and Midland Junction.
3. White, or light coloured upper panels	4,961	22	8 Railways. London and North Western: Chocolate, white panels. Caledonian: Dark lake, white panels. London and South Western: Walnut, pale salmon panels. Great North of Scotland: Purple-lake, cream panels. Furness: Blue, white panels. Taff Vale: Dark brown, white panels. Cleator and Workington Junction: Lake, white panels. Maryport and Carlisle: Green, white panels.
4. Varnished teak or other wood	3,944	17½	11 Railways. Great Eastern, Great Northern, Great Central, Great Northern (Ireland), Midland and Great Northern Joint, Cheshire Lines Committee, Hull and Barnsley, Isle of Wight Central, Isle of Wight, North London, Manchester South Junction and Altrincham.
5. All others not included in above	1,601	7	5 Railways. Lancashire and Yorkshire: Purple-brown with cinnamon-brown panels. Somerset and Dorset Joint: Blue. Highland; Cambrian; Cork, Bandon and South Coast: Green.
Total	22,610	100	

them. The mileage of the Rhondda and Swansea Bay and Port Talbot Railways has been left as Great Western, by which company it is returned, although they have distinctive rolling stock and engines, but the total figures and percentages would hardly be affected by placing them in the groups to which they more accurately belong.

Group 3 of the passenger rolling stock would, only a short time ago, have been by far the largest, amounting to about 50% of the total, but some startling alterations have recently been made, completely changing the relative figures under several headings · the Great Western have substituted a somewhat sombre red-chocolate-brown for the attractive tea-brown with ivory-white upper panels of former days, the Great Central have reverted to varnished teak after an interval of brown with cream-white upper panels, the Highland and Cambrian have both discarded the white upper panel, while the London, Brighton and South Coast, after first changing from mahogany to umber, with umber-tinted white upper panels, has finally selected umber alone for the whole exterior.

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TABLE II.—PASSENGER ENGINES.

Colour.	Miles.	Percentage of Total.	Railway.
1. Green (all shades)	11,558	51¼	15 Railways. Great Western, North Eastern, Great Northern, London and South Western, Great Central, South Eastern and Chatham, Great Northern (Ireland), Midland Great Western, Glasgow and South Western, Great North of Scotland, Cambrian, Cork, Bandon and South Coast, Belfast and County Down, Maryport and Carlisle, Highland.
2. Black	4,377	19½	11 Railways. London and North Western, Great Southern and Western, Lancashire and Yorkshire, Dublin and South Eastern, Taff Vale, Hull and Barnsley, Stratford-upon-Avon and Midland Junction, Rhymney, Isle of Wight Central, Wirral, North London.
3. Blue	2,399	10½	3 Railways. Caledonian, Great Eastern, Somerset and Dorset Joint.
4. Lake and red-brown ..	2,236	10	7 Railways. Midland, North Staffordshire, Furness, Barry, Midland and South Western Junction, Brecon and Merthyr, Isle of Wight.
5. Others not included in above	2,040	9	3 Railways. North British: Dark gamboge. London, Brighton and South Coast: Umber. Midland and Great Northern Joint: Golden ochre.
Total	22,610	100	

Various dark shades such as maroon, chocolate, brown, and what one must term red-brown, seem to be at present the most popular colours, being in use on 11 railways and accounting for 27½% of the total, while 7 railways, representing 26% of the total mileage, employ crimson lake or dark red as their livery. Varnished teak, always a smart looking and pleasing livery, is now used by 11 railways on 17½% of the total mileage.

As regards passenger engines, green is undoubtedly the favourite colour, as no less than 18 railways, representing 51¼% of the total mileage, use it. Black appears to be next in favour as 11 railways (19½%) have it as their locomotive livery; while shades of lake and blue account for 10% and 10½% respectively. The changes in engine colours have been fewer than in those of carriages, the London, Brighton and South Coast again being notable, however, for the substitution of umber for the former unique and attractive tint of ochre, while the really artistic olive green of the Highland engines, has been superseded by an entirely different shade of the same colour. Many of the railways, including the London, Brighton and South Coast, have now adopted black as the colour of all their goods engines.

No attempt has been made to describe or distinguish the different colours of "linings" or "pickings out" on either rolling stock or engines, although in many instances these afford a distinctive character to colours otherwise the same.

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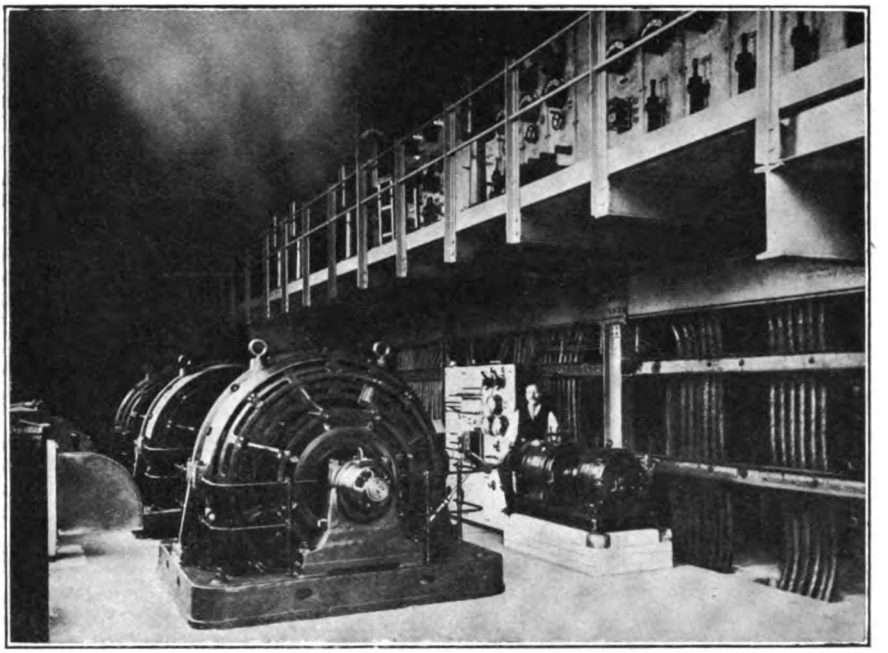

INTERIOR OF NEW SUB-STATION AT DRAYTON PARK: METROPOLITAN RAILWAY.

New Sub-station at Drayton Park: Metropolitan Railway.

AS a separate concern the Great Northern and City Railway had its own power station at Poole Street, Hoxton; and this arrangement continued for some time following the acquisition of the line by the Metropolitan Railway Company. Current is now, however, supplied from the Metropolitan Railway power house at Neasden, *viâ* the Moorgate Street sub-station, a new sub-station for the "tube" line having been erected adjoining the Drayton Park station, and the old generating station at Poole Street, Hoxton, dismantled. This arrangement is stated to have realised considerable advantage already.

By the courtesy of officials of the Metropolitan Railway we are able to illustrate and describe the new sub-station. It is equipped with nine single-phase air-cooled transformers, each of 360 kw. capacity, and three 800 kw. six-phase self-synchronising rotary convertors, giving the station a total full load capacity of 2,400 kw. Space has been left for the addition of a fourth unit when required.

The transformers convert the alternating current from 11,000 volts to 440 volts, six-phase, and are cooled by three motor blowers, each of which is connected to a bank of three transformers by means of a galvanised air shaft. Regulating dampers are provided so that any one transformer can be shut off, or the whole can either exhaust to atmosphere or into the sub-station for warmth. Each blower is driven by a 4-h.p. three-phase motor. The rotary convertors convert the 440-volt alternating current to 600 volts direct current for supplying to the track. High-tension current is supplied through special switch-gear from the Company's sub-station at Moorgate Street, a distance of about 2·8 miles, which, in its turn, receives its supply from the main generating station at Neasden, about 9½ miles distant.

Included in the equipment of sub-station is an overhead travelling crane, which runs the whole length of the building. Also two 10 kw. motor generators, and the necessary switchgear, have been installed for the purpose of supplying current for working the automatic signals on the line.

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Some War Effects as seen in the Rates Office.

By A RATES CLERK.

IT is scarcely likely that anyone wishing to see the effects of the War upon railway life and work would select the Rates Office as the most suitable spot from which to make his observations. The movement of troops and war material, changes in the working of the ordinary traffic, both passenger and goods, and the really admirable manner in which the railway service as a whole has responded to the unparalleled demand made upon it, may be witnessed more effectively elsewhere. At the same time there are certain aspects of the consequences following on the tremendous upheaval we have experienced which may be viewed with some advantage from the detachment such a place as the Rates Office affords, and some of the results to be seen within its walls are not without interest or significance.

Perhaps the first and deepest impression made upon the mind of the majority of Rates clerks during these weeks of War is the appropriateness of the expression—"Business as usual." Outwardly there has been but little change. Applications continue to pour in day by day from the stations and the general public requesting rates for the various descriptions of traffic passing or expected to pass by rail, and these are receiving attention on much the usual lines. Pianos and dolly-tubs, coal and carbolic acid, live stock and boots, miscellaneous and varied articles of many sorts and values, all must be provided for as in the days before the War, strong evidence, surely, of the wonderful way in which the trade of the country generally has been maintained.

But there are differences. Here and there a face is missing in the office. Young men have volunteered. It is much to the credit of the railway world that so many of its workers have rallied to the nation's call, and among them are not a few from the Headquarters staffs. Hence the decorum of the office is disturbed now and then by the unexpected inrush of a bronzed individual in khaki, home for a brief spell from training camp or front, who not so long ago was accustomed to sit at one of the desks.

When the actual work of the office is considered, adjustments directly or indirectly due to the War become more evident, and, though most of these are comparatively slight, some of them are highly significant. From the letters received two or three deductions may fairly be drawn as to effects on the country's trade and on the movement of traffic over the railways. It may be said, for example, that the War has resulted in the diversion of certain articles of commerce to unaccustomed routes. Pitwood may be instanced as a case in point. Ordinarily immense quantities of this essential traffic to the colliery districts are carried through the North Eastern and Humber ports on the way from Norway and Russia, but the supply from that direction has been very greatly reduced, if not entirely suspended. Accordingly an effort has been made to meet the demand by supplies from the home counties, and rates have been called for from a large number of country stations to the great mining centres. So important, indeed, has this matter become, the raising of coal being so vital to the life of the country and the successful carrying on of the War, that altogether exceptional arrangements have been adopted to meet the situation, and with the authority of the Executive Committee specially low figures have been quoted where necessary as emergency rates for the period of the War only

Another fact disclosed by the Rates Office correspondence is that in some directions entirely new traffic has been created, and that for more than one reason. Some of it is due to the endeavour to cut out the Germans. Alert and enterprising firms in this country have realised the unusual opportunity of securing trade hitherto in the hands of the enemy, and rates are required for articles now made in England which in the past have borne that unpopular brand—"Made in Germany." Certain forms of glass work used in connection with electric lighting, china dolls and other sorts of toys, to say nothing of articles of larger and more costly make, may be mentioned under this head. Moreover, very large quantities of

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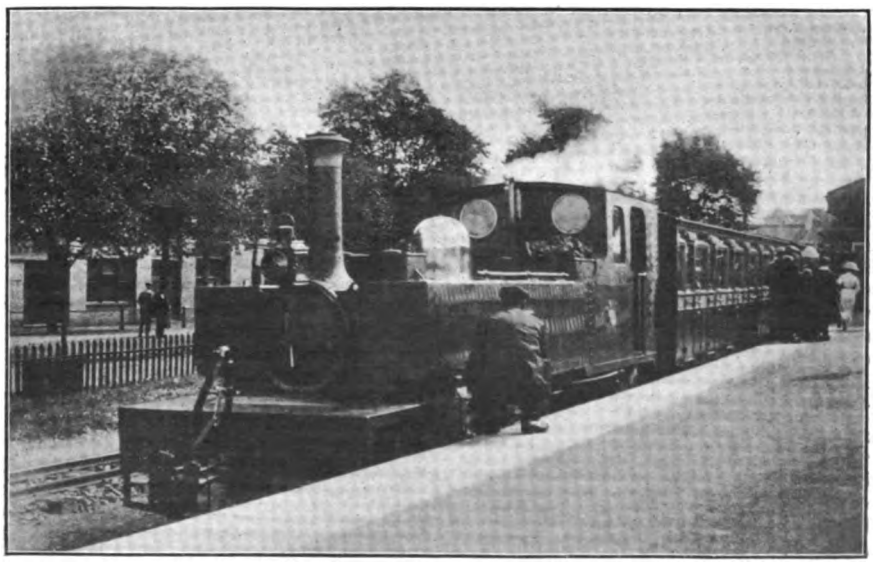
many and varied kinds of material required by the War Office and the Admiralty, and supplied by contractors in all parts of the country, have been passing to and fro to an unprecedented extent, which hitherto have been totally unprovided for so far as rates are concerned, and many have been the applications for special terms. A few of the applications, indeed, have been of a somewhat suspicious character, and have suggested an effort in one or two quarters to send material *viâ* neutral countries on the way to Germany. Needless to say suitable steps have been taken in such instances, which fortunately have been rare.

Probably, however, the most far-reaching development brought about by the War conditions is the curtailment of what may be termed "competitive" rates, that is, rates given with a view to encouraging traffic from particular districts or traders, or by particular routes, to the detriment, more or less, of others. This feature is not, perhaps, so obvious, and, from an outside point of view, not so impressive as some of those already mentioned, but it would be difficult to estimate its importance so far as it affects the future relations of the railways, the traders and the State. Unquestionably the control of the railways by the Government has foreshadowed vast possibilities. The Companies have realised as never before some of the advantages which unity of control assures. The wastage due to excessive competition to a great extent has been eliminated, and, although on the one hand the traders may urge they are the losers by the withdrawal of "cut" rates, it may fairly be contended on the other that, seeing reduction of rates from one district usually leads in time to a corresponding reduction from competiting districts also, they are relatively in no worse a position than they were before.

There is a growing opinion that, whatever happens, matters will never again be exactly as they were, and although it is unwise to prophesy unless you know, it is more than probable the work of the Rates Office, as well as that of the railways as a whole, will be permanently affected on account of the experience gained during these months of crisis. To what extent and in what direction alteration will be made time alone will show, and there is nothing for it but to—"Wait and see."



Photo] [*F. H. Stingemore.*

LYNTON AND BARNSTAPLE RAILWAY.

Train at Barnstaple Town Station.

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Railwaymen with the Colours.

AT the annual meetings of the various railway companies appreciative remarks were made by most of the Chairmen of the services rendered by their men to the nation, either by joining the colours or by carrying out Government work in the railway shops or in dealing with the very heavy special traffic occasioned by the situation. A selection of remarks bearing on this point will be of interest, collected in a convenient form for reference and permanent record. Matters dealt with last month are repeated for the sake of completeness. Extracts are given substantially in the words of the respective speakers :—

Sir Henry Mather Jackson, Bart., Alexandra (Newport and South Wales) Docks and Railway. Of our regular staff 144 have been called up for service with the Forces, or have voluntarily enlisted, being 14·21 per cent. of the permanent employés. They will be reinstated upon their return, and the period of their absence will count as ordinary service. Their wives or dependents are also receiving allowances in accordance with the approved scale. In addition to these men of our regular staff over 100 dock workers usually employed by the Company have been either called up or have enlisted voluntarily. In this connection I should perhaps mention that Mr. T. W. Pearson, locomotive superintendent, who, just before the war, was appointed as the Company's engineer, was one of those called up to serve with his battery, in which he is a major. His place has been temporarily taken by Mr. J. D. C. Cooper, who was resident engineer for Sir John Wolfe Barry for the dock extension works during the whole time the extension works were in progress.

Rt. Hon. Thomas Andrews, D.L., Belfast and County Down Railway. One of the Directors, Mr. R. D. Perceval Maxwell, has accepted a commission in His Majesty's Army, and has been gazetted major in the Royal Irish Rifles. In addition, about 10 per cent. of our staff have either been called to the Colours or joined Lord Kitchener's Army for the period of the war, and we have undertaken in respect of these men to keep their positions open for them, and to pay their dependents a sum of 5s. per week.

Sir Charles Bine Renshaw, Caledonian Railway. The special work they had been called upon to do since the war began, had been very considerable, but those in the departments specially affected had worked splendidly and in a most patriotic spirit, and he knew that they had taken a pride and pleasure in feeling that they were doing all they could to assist in carrying to a successful issue the great conflict in which the nation was engaged. (Applause.) Their General Manager, Mr. Matheson, who, as they knew, was the representative of Scotland on the executive in London, deserved every praise for all he had done, and he was afraid that Mr. Matheson had had to bear a very heavy strain, and he felt certain that he was expressing not only the shareholders' view but the views of other Scottish railway companies when he told Mr. Matheson how much his work had been appreciated. A large number of men in the service of the Caledonian Railway Company had either been called up as Reservists or had enlisted. He thought that now there were about 2,000 of their men serving with the colours, and in common with other companies they had to prevent many from going who wished to do so, as it was essential that they should be retained in order to work the line and so secure the movement of troops, stores, etc. He felt that those who had remained and done their duty in this way had been serving the State as truly as those who were serving with the colours. Three members of the Board of Directors—Messrs. Houldsworth, Walker, and Gilmour—are serving with the colours.

Mr. Thomas Craven, Cambrian Railways. Our Chairman, Mr. David Davies, is busily engaged in the training of the new Welsh Army Corps in which he holds a commission as lieut.-colonel. He will probably be leaving for the Front shortly. . . . Shortly before and since the outbreak of the war we have dealt with a very considerable percentage of our men who have either been summoned to or have voluntarily joined the colours, and to those men of military age who cannot now be spared from their duties we are arranging to provide badges issued by the Railway Executive Committee, showing that they are engaged in the railway service, and are therefore ineligible for recruiting.

Right Hon. Charles B. Stuart Wortley, City and South London Railway. During the mobilisation in August—that is for a period of several weeks—we carried soldiers and sailors free. From the Underground Electric group the number of employés serving in the war is no less than 1,300 men, or 20 per cent. of the whole. The City and South London Railway Company made their fair contribution and deserve their proportionate share of the credit.

Mr. Frederic W. Pim, Dublin and South Eastern Railway. Some fifty young men have left the Company's service for the Army. In common with the other companies, we have engaged to keep places for them on their return, and to preserve their status for promotion and superannuation as if there had been no interruption of the continuity of their service. Arrangements have also been made for contributing in suitable cases to the support of dependents, supplementary to the subsistence allowances granted by the War Office regulations.

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Lord Muncaster, Furness Railway. The Furness Railway, as in the case of other railway companies, have been carrying out work for the Government in our workshops so far as we are in a position to do so. We are also very short of men, as a considerable number of our employés have been called out to join their several regiments or enlisted. The men are not now allowed to enlist except by permission of the heads of departments, as the Government consider that by remaining in the railway service they are doing the State as great a service as being with the colours. Many of our men have also left our service to join the naval construction works of Messrs. Vickers, at Barrow, where they are now employing over 20,000 men. We are endeavouring to obtain British workmen . . . but we may be compelled to bring into our employ suitable Belgian workmen.

Sir Alexander Henderson, Bart., M.P., Great Central Railway. The war has thrown upon the Company's officers an immense amount of arduous work, and I think I am right is saying that not only our officers, but also all the men in the Company's service, have worked well and willingly to meet the situation, the like of which has never been known here before. The difficulties of working have been greatly added to through the large number of our men who have responded nobly to the country's call for assistance in the hour of danger. All classes of our employés have been eager to take their active share in the work of meeting the nation's emergencies. 3,778 men, or equal to 11 per cent., have joined the colours, and in some departments it has been absolutely essential for the Company to adopt restrictions in order to prevent men enlisting, as otherwise the efficient working of the line would have become an impossibility. I need hardly say that the Company is making adequate allowances to those men who have joined the colours, giving them an undertaking that their places will be open for them when the war is over.

Lord Claud Hamilton, M.P., Great Eastern Railway. Out of our staff, numbering some 33,000, 3,600, or more than 10 per cent., have joined the colours. About fifty of these at the front have already, I am sorry to say, been killed ; but we, of course, on your behalf, are looking after the dependents of these men. The moment the war was started we formed a Great Eastern War Relief Fund with a Central Committee under the Chairmanship of one of the chief officers, with another chief officer as hon. secretary, ably aided by sub-Committees which were established throughout the districts served by the Company. In many cases members of the wage-earning staff of the Company served on these sub-Committees. The Central Committee through these district branches, has been able to be in the position of having every detail and every fact connected with the cases of those 3,600 men brought before it in a few hours.

Mr. Fane Vernon, Great Northern Railway of Ireland. Of our comparatively small staff 316 are now serving their King and country with the colours. Your Directors have made arrangements so that their dependents may not suffer by the patriotism of the breadwinners who volunteered, and I am sure that the shareholders will approve of this being done. Let us wish these men good luck, and a happy return to their friends, to the Great Northern Railway, and to Ireland.

Sir William J. Goulding, Bart., Great Southern and Western Railway. He was glad to say that many of their own Great Southern and Western men had rallied to the call of their country, and were at the front doing their duty nobly, while they were proud to have noticed that Sergeant-Major Jackson. a locomotive foreman at Maryborough, was one of the first to receive the French Order of Merit for distinguished service in the field. They had promised to keep their places open for them, and wished them a speedy and safe return to their posts. They had meantime provided assistance for those they had left behind. A railway such as theirs, which had to serve the country in large carriage of soldiers and military equipment, could not spare so many men from the running staff as in other employments.

Viscount Churchill, Great Western Railway. I am sure you will be very glad to hear that upwards of 10,000 of the Company's employés are now serving with the colours. This represents something like 12½ per cent. of the total staff, being drawn from the salaried and wages staff of all grades. You will, I am sure, approve of the fact that we have undertaken to keep open positions in the service for this staff on resumption of civil life. Assistance is also being afforded by the Company to the wives and families and other dependents of a number of these men in accordance with carefully compiled regulations which take into account the wages which were being paid, the separation allowance granted by the Government, and the necessities of the case. You can well imagine that with this large number of men having left the Company—many of our very best men—it is taking us all our time to carry on our business efficiently. It has, therefore, been found necessary to exercise a wise discretion in giving permission to others to enlist, and I am sorry to say that this permission has had to be refused in a good many cases. It must, however, be realised—and I am sure that any thinking man will recognise the justice of this remark—that in maintaining the efficient services of our railways as lines of communication and supply, these men are serving their country as effectively as though they were actually engaged with the colours.

Col. C. W. Trotter, Hull and Barnsley Railway. Nearly 600 of the Company's employés are now serving with His Majesty's forces, this number representing about 20 per cent. of the total staff employed.

Mr. Harry Willmott, Isle of Wight Central. Our Director, Lord Willoughby de Broke, is with his mounted troops preparing for the front. Of our staff 12 per cent. are serving with the colours.

Sir George Armytage, Bart., Lancashire and Yorkshire Railway. 4,189 members of the

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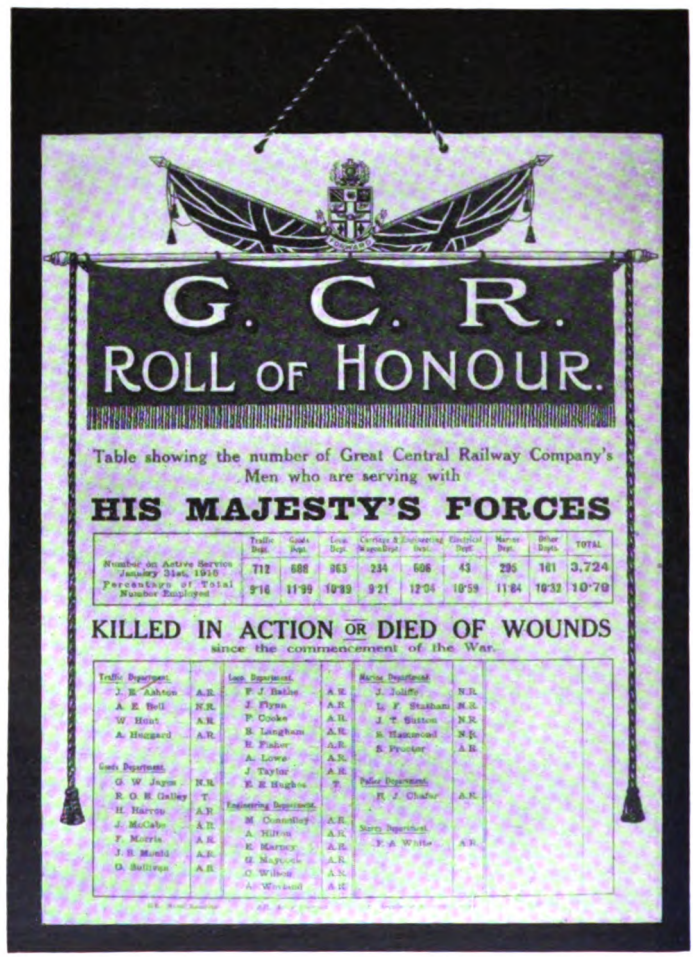
Company's staff have enlisted in His Majesty's forces. With regard to those members of our staff who have enlisted in His Majesty's forces, we have in conjunction with other railway companies adopted a scheme for supplementing the Government allowances to the men's dependents by such amounts as will ensure their families being able to keep their homes together without experiencing undue hardship. This scheme has been approved by the Government, who have agreed to accept, as a working charge, a large proportion of the amount so expended. It has been decided to issue badges to all railwaymen of military age who cannot be spared from their duties, such badges signifying that the wearers are already performing a national service. The badge bears the Royal Crown, the use of which has been sanctioned by His Majesty the King. I should like to express to the shareholders how much we and they are indebted to the officers and staff for the manner in which they are carrying out their duties, which have been greatly increased not only by the additional work entailed by the Government control, but also owing to the depletion of the staff—in fact, many of the officers have had little or no holiday.

Mr. H. C. Woodward, Liverpool Overhead Railway. Out of our employés, forty-two have joined His Majesty's forces, which is equivalent to about 12 per cent. of the whole of the staff.

Sir Gilbert Claughton, Bart., London and North Western Railway. We have temporarily parted with some of our best officers and 12,177 of our men for the service of the Government and we are proud of them, but it has not been unattended by many casualties which we deplore. The list according to the latest information is: 120 killed in action, drowned, etc.; 39 died from wounds, etc.; 641 wounded, sick, etc.; and 202 missing or prisoners of war; making a total of 1,002.

Mr. Hugh W. Drummond, London and South Western Railway. Now, you will see outside this room a roll of honour—a list of men who


G. C. R.
ROLL OF HONOUR.
Table showing the number of Great Central Railway Company's Men who are serving with
HIS MAJESTY'S FORCES
KILLED IN ACTION OR DIED OF WOUNDS
since the commencement of the War.

GREAT CENTRAL RAILWAY "ROLL OF HONOUR."

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have gone to fight for their country. We can ill afford to spare our men. I have never given the men much encouragement to enlist, because I have always felt that we are on the lines of communication, and in a great national emergency, such as we are going through, it is very important that we should have all the men necessary to carry on our work. However, 2,424 men are serving with the colours at the present time. All departments are represented. Many more men, I know, would go if we could spare them, but we have asked them not to, for we consider that the work which they are doing here on the various railways is just as important as that which they would be doing if they were at the front. Of this number that I have quoted, thirty-eight have died on active service, being either killed in action, or have died from wounds, or from other causes; but we hope that the remaining number may be spared to come back to us in due course. Our chief officers in every and each department have been working almost up to breaking point. I have visited the traffic department at all hours of the day and night, and have been struck by the almost utter impossibility of the difficulty experienced in getting our men away from their work. If they are on a job no power on earth will get them away from it until it is finished. Mr. Holmes and the other chief officers have almost had to use force to get their men away from their work in order to get necessary absolute rest and fresh air. It is simply wonderful. I believe the Naval and Military authorities fully realise what they owe to the railways. Never has hard work been more freely given, and never has the country been better served than by those on our railways. I have only one more word to add, and that is, I am extremely glad that an undertaking has been reached whereby our men receive a substantial bonus during the period of the war and the high prices ruling now.

Earl of Bessborough, London, Brighton and South Coast Railway. The splendid response of railwaymen all over the country to the call to the colours is another matter for congratulation, and in this respect the staff of the Company has not been behindhand. No doubt you have seen the Roll of Honour, posted at the principal stations, showing that between 11 and 12 per cent. of the total staff have joined the Naval or Military Service, and if the figures could be made to relate only to men of military age the percentage would, of course, be considerably higher. We have to deplore the loss of many of these men by death in action or from wounds, and I may mention specially that no less than seven of them went down with H.M.S. "Good Hope" and Admiral Cradock in his gallant fight in the Pacific Ocean. The conditions in relation to the Company under which the men have enlisted are that their positions in the service will remain open to them if they return able to take up work, or they will be given other positions at the same rate of pay, and their contributions to the pension fund covering the period of absence will be borne by the Company. It is agreed also that allowances to their wives and children or other dependents shall be made according to a scale based upon their rates of pay, or upon the allotments they are able to make out of their Navy or Army pay, and these allowances are no doubt a welcome supplement to the separation allowances granted by the State. Volunteers have been so numerous, and the Company was getting so short of men, that it became necessary, in concert with other railway companies, to make a rule that no man should enlist without first obtaining the permission of the head of his department. It has been decided to issue a badge to men of military age who may be debarred by this rule from enlisting, to be worn as an indication that the employment followed by the wearer is a national service and with the approval of His Majesty it incorporates the Imperial Crown.

Mr. T. Hartley, Maryport and Carlisle Railway. They employed, roughly speaking, between 500 and 600 men, of whom only 215 were of military age and eligible for service, so the number (31) who had joined worked out at something like 15 per cent. The railway companies had taken that into consideration, and had agreed to issue to all the companies' men who cared to have it a badge which was to be given to those who would like to join, and could have joined the Army, but were debarred.

Lord Aberconway, Metropolitan Railway. Our staff has been considerably depleted by men joining the colours. About 130 men have responded to our country's call, and I am sorry to say that of this number seven have already fallen on the field of honour. We are, of course, looking after the wives and other dependents of the men who have gone abroad, and have guaranteed to each man to find him employment when he returns. I should also like to mention here that as soon as our men began to be called up, the older men in the service formed a Committee amongst themselves and established a fund which is supported by all grades of the men in the Company's employ for the purpose of meeting any cases of distress that arise amongst the dependents of the men who have joined the Army. In this way about £30 a week is being contributed by our men, and disbursements are made weekly by the Committee as occasions arise.

Lord George Hamilton, Metropolitan District Railway. Since the outbreak of war, a very considerable number of the officers and staff of all the companies who were working in connection with the Underground were summoned or enlisted for war service. I am proud to think that the Underground group supplied a large number of men in answer to this call.

Mr. G. Murray Smith, Midland Railway. There are up to date nearly 9,000 Midland men who have joined either the Army or Navy, and of these, I regret very much to say 102 have lost their lives either in action or from wounds or from disease, 29 men are missing, 369 men have been wounded or invalided hime, and 100 are prisoners of war. Ample provision has been made for the wives, families, and dependents of the men who have joined the colours, so that

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our men can go forth with the knowledge that those they leave behind will be well looked after and cared for during their absence, and that they themselves, if spared, can return, at the conclusion of the war, to their duties on the Midland Railway.

Major H. C. Cusack, J.P., Midland Great Western Railway. There were now serving with the Expeditionary Forces, or with the battalions at home, ninety-eight men from this railway. enlisted now amounts to 6,200, which is over 12 per cent. of our total staff. Arrangements have been made in the case of all these men for supplementing their separation allowances which are granted by the War Office, so that all North Eastern men leaving to fight for their country are able to do so with the confident assurance that those dependent upon them will be amply provided for. The Company, in September, undertook to raise, equip, house, feed, and

LANCASHIRE & YORKSHIRE RAILWAY
FOR KING AND COUNTRY
HEAD OFFICES
HUNTS BANK
ROLL OF HONOUR
Names of Staff employed by the
LANCASHIRE & YORKSHIRE RAILWAY Co.
who have joined the Colours.
The Total Number of staff employed by the Lancashire & Yorkshire Railway Company who have joined the Colours up to Dec 5th 1914 is 3794
JOHN A. F. ASPINALL.

LANCASHIRE AND YORKSHIRE RAILWAY "ROLL OF HONOUR."

They had promised to take these men into their employment when they returned, as they hoped they would, and they were also giving the wives of those who were married, and to the dependents of unmarried men, some little assistance to help them to keep their homes, the amount in each instance being fixed on a graded scale proportionate to the number of dependents.

Lord Knaresborough, North Eastern Railway. The total number of North Eastern Railway men locally train a battalion of the Northumberland Fusiliers composed exclusively of North Eastern Railway men. This was in response to a widely expressed desire on the part of our men to serve together, and in response to a general invitation from the War Office to individuals and communities to assist in this way in raising service battalions of infantry. The response of the men was prompt and very ample, and numbers considerably in excess of those required could have

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been obtained had the work of the Company permitted the men to be spared. The battalion is now clothed and equipped, and its training is proceeding at the King George Dock, at Hull, where by the courtesy of our partners in the dock, the Hull and Barnsley Railway, we have been able to house the men in two warehouses. These are the very two warehouses which were utilised in June for the reception of the King and Queen on the occasion of the opening of the dock. All expense of feeding, clothing, equipping, etc., is refunded to the North Eastern Railway by the War Office, and the actual cost to the Company involved by the obligations under which they came will be slight, as practically all the work in connection with the formation of the battalion has been undertaken by the officials of the Company, in addition to their ordinary duties. I think you ought to be grateful to them for the extra work they have undertaken on its behalf. The War Office has asked the Company to provide a fifth and sixth company as reserves, and it is hoped that we shall be able to spare men to form these. The total numbers will then be about 1,600 of all ranks. When the battalion reaches the front drafts from those reserve companies will enable it to retain its distinctive identity as a battalion of North Eastern Railway men. The War Office in order to utilise to the full the large amount of technical ability in the corps, has converted it into a pioneer battalion, where those qualities will be of greater service to the country than if it remained an ordinary infantry regiment.

Lord Rathmore, North London Railway. It only remains for me to refer to the men in our employment, who, much to their honour, have in the hour of their country's need willingly answered the call to the colours. They number upwards of 200, which, in the case of our small Company, represents 12 per cent. of the whole of our employés. I am confident that you will approve of the provision which, as we have stated in our report, we have made with a view of supplementing the State allowance to the dependents of these Volunteers by a sum which will enable them to live in reasonable comfort during the absence of the bread-winners, for whom positions will be found on their return to civil life. . . . I deeply regret that I must add that since our report was published we have heard of the death of one of the members of our Board—Mr. Vincent Hoare. Mr. Hoare became a Director in 1907, and was our representative at the Railway Clearing House. He was a member of the famous banking house in the City, but when the war broke out he joined the colours, and held the rank of major at the time he lost his life fighting gallantly for his country.

Mr. Tonman Mosley, North Staffordshire Railway. Five hundred and four of the Company's staff were serving with the Colours. They had agreed that positions should be found for them on their return to civil life, and that they should then receive a salary or a wage according to the scale to which they would have been entitled if they had remained at work. Suitable provision was also being made for the wives and families and dependents of the men during their absence. It was possible that they would come later on and report to them what they might do in the way of putting up some sort of a memorial plate to those of the staff who had won an heroic place in their memories. Under the ægis of Mr. Phillipps, the general manager, and the colonelship of their indefatigable accountant, Mr. Jones, they had started a North Staffordshire Railway drilling and shooting corps.

Mr. H. Cosmo Bonsor, South Eastern and Chatham Railway. As regards our employés who were called to the colours, we had some 2,000 men who were called out or who enlisted; and here I must say that we can spare no more. We have had to stop a number of our men from joining the colours because their services are just as much of use in the national interest in carrying on the railway service as in fighting the Germans. We at once thought that it was our duty as employers to see that none of the dependents of those 2,000 people who were called out should have pecuniary embarassments added to their anxieties. The wives of our officers formed Ladies' Committees in every part of our system, so that every dependent should be personally visited and their necessities inquired into. Those ladies were good enough to report to a Committee, presided over by Mr. Mellor, of Directors and officers at London Bridge, so that relief could be given at once. We undertook that before the State had published what they intended to do in separation allowance; but even since then we have found certain cases of special hardship where the State had not given sufficient for a dependent to keep up the home in the absence of her husband or her son abroad, and we have made special arrangements.

Sir Joseph Weston Stevens, Taff Vale Railway. The employés of the Company had responded nobly to the call of the country, 662 having joined the forces, or equal to 13½ per cent. of the total employed. This, he thought, was one of the highest percentages shown by any railway company. They had promised to keep the positions of these men open, and to make a suitable allowance to wives and children. Of the directorate, he had to apologise for the absence of Colonel Homfray and Major Wait, both of whom were on service.

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War Traffic Statistics.

A SPECIAL feature of many of the Chairmen's speeches at the railway companies' annual meetings was a statement as to the numbers of special trains run for troop and military traffic since the outbreak of war, and these also may be collected for reference and permanent record:

Lord Muncaster, Furness Railway. The work consequent upon this control (by the Railway Executive Committee), I need scarcely say, has been very great, and when I tell you that about 220 instructions have been issued by the Railway Executive Committee to the several railway companies, you will understand the enormous and continuous labour and strain which this has necessarily brought about, not only to the Committee, but also to the railway staff, for it means that the General Manager must advise the several heads of departments concerned under each instruction, the issue of circulars to the staff and frequent conferences between the General Manager and the chief officers to see that the wishes of the Government are strictly and promptly carried out. I am assured by the General Manager that the officers and staff of the Furness Railway have all worked in a harmonious, loyal and patriotic manner in regard to these instructions, and the extra work which they have necessarily involved has been ungrudgingly and without demur carried out.

We have during the last few months been placed to considerable difficulty in supplying the necessary wagons required for hauling the traffic from Messrs. Vickers' works, who have large Government orders on hand, the Barrow Hematite Steel Company, and the other iron and steel works on the Furness line and in the West Cumberland district, and supplying wagons required by our other traders, and for the iron ore mines. The goods managers of the several railway companies have recently been in conference on this question, and I am informed it is estimated that at the present time about 10,000 wagons are under load at their various destinations waiting to be unloaded, owing to the congestion which has taken place, and which to a great extent has been, in the rush of Government traffic, unavoidable. So important has this question become that it has been arranged to take a census of all wagons belonging to other companies on the various lines.

We are obliged to have new carriages to meet the continuous progress in our passenger business, and also the increased number of workmen who are now travelling to Messrs. Vickers' and other works from various parts of the line, the number of weekly workmen's tickets now being 2,900.

We are extremely fortunate in our General Manager and Secretary, Mr. Alfred Aslett, whose work has been very great, as I know myself. He and the whole of our staff have devoted their entire energies, perhaps even more than their health would at times permit, in their services to the Furness Railway. He thought the shareholders and certainly the directors owed a very great debt of thanks to each and all of them for the way they have acted and the way in which the men under them have worked, with a due sense at the bottom that they are doing good and patriotic service to the State.

Sir James Bell, Glasgow and South Western Railway. In addition to the service of transportation the companies had largely placed their manufacturing establishments at the disposal of the Government with a view to assisting in the manufacture of military stores and equipment, which private firms and the Government factories had difficulty in turning out speedily enough. Valuable services have been rendered to the Admiralty by the companies owning steamboats, services by no means limited to the conveyance of troops and stores by normal traffic routes.

Sir Alexander Henderson, Bart., M.P., Great Central Railway. As an indication of the kind of work done upon Government account, I may mention that on the Great Central we have carried upwards of a quarter of a million soldiers (in addition to those carried upon the occasion of temporary leave), more than 16,000 horses, and some 1,400 service vehicles. The Executive Committee of Railway General Managers, of whom our own General Manager is one, appointed to manage the railways of the country, have had most arduous duties to perform, and the best thanks of the community are due to them for their strenuous and efficient efforts to deal with an unprecedented situation. The railway companies have placed their manufacturing establishments at the disposal of the Government with the view of assisting in the manufacture of military equipment which could not be dealt with by the regular contracting firms. The companies have not sought to make profit for themselves out of this work, but they have stipulated that arrears of repairs of railway works and plant brought about in consequence of the execution of Government work should be recognised as constituting a fair charge against the Government.

We refer in the report to the fact that the whole of the Company's Continental steamship service has been discontinued. Naturally, with a mine-strewn area the service to Antwerp and Rotterdam would have been too risky for the Company to operate, and the Company's chief service to Hamburg has of necessity been suspended owing to the hostilities. It is with regret we have to report that three of our steamships,

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the *Bury*, the *City of Bradford*, and the *City of Leeds* have been interned at Hamburg. These ships had all sailed from Hamburg, but were stopped by German patrol vessels prior to the declaration of war at the mouth of the Elbe and ordered to return to Hamburg. There they have since remained, the officers and crews having been sent to a concentration camp in the interior of Germany.

Lord Claud Hamilton, M.P., Great Eastern Railway. We have run, from August until the end of December, 2,793 special military and naval trains—an average of 15 special trains per day—in addition to the carriage of numerous isolated bodies of troops. Our hotel at Harwich has been converted into a military hospital, and an excellent one it makes. The great quay at Parkeston, usually devoted to the Continental traffic, has been handed over to the Admiralty, with the exception of two berths, and it has proved invaluable for naval purposes. In fact, having regard to the altered conditions of naval warfare, and to the presence of great German naval stations across the North Sea, I do not see how our Navy could have been able to effectually maintain its position in that sphere of action, but for the assistance of Parkeston Quay. Our hotel at Parkeston has been run at very low prices in order to be within the reach of naval and military officers who are employed in the vicinity, as well as their wives and relatives. Many of our best steamers have been requisitioned by the Government, and at present we have five under Admiralty control. Having regard, however, to the great importance of maintaining an adequate supply of the necessaries of life in this country, we are still running a service of cargo boats between Parkeston Quay and Rotterdam of six sailings per week for the conveyance of foodstuffs.

In addition to the service of transportation, the companies have largely placed their manufacturing establishments at the disposal of the Government with a view to assisting in the manufacture of military stores and equipment, which private firms, and the Government factories, had difficulty in turning out speedily enough. The companies have not sought to make a profit for themselves out of this work, the only stipulation being that arrears of repairs, and renewals of railway works and plant, brought about by the execution of Government work, should be recognised as creating a fair charge against the Government. Valuable services have also been rendered to the Admiralty by the companies owning steamships, services by no means limited to the conveyance of troops and stores by normal traffic routes.

Lord Allerton, Great Northern Railway. At the London end we have been asked to carry goods from the docks as soon as we could get them, but we have not been able to get them so quickly on all occasions as we might desire. As a company, we have dealt with and handled more wagons at the London end than have ever been handled at any previous time in the history of the Company, and any delays that have occurred have been beyond our control. We are giving preference to food and fuel, which are necessary to daily life. The gas companies have also asked us for assistance, as they have not been able to get supplies by water from the North and from Wales, those supplies having been practically cut off. I think that we have now mastered the main difficulties, and I think that the docks and the Port of London are getting more under control than they were. The people of Bradford, who are dealing with large quantities of wool for making Army clothing, have also been very urgent in their requests with regard to the carriage of their goods. We have practically placed our manufacturing establishments at the disposal of the Government wherever they could be utilised in order to assist the Government and the War Office and Admiralty in providing tools and materials and necessaries for the services, and that has occupied a considerable portion of the time of our men.

Mr. Fane Vernon, Great Northern Railway of Ireland. At the request of the War Department this Company has fitted up and equipped an ambulance train, composed of nine bogie vehicles, with a total length of nearly 500 ft., which is being used for the conveyance of wounded soldiers. The work of adaptation of the rolling stock to this purpose cost about £1,300, and for the time being, its use leaves the Company somewhat short of vehicles of a certain type; but it was our duty to do all that we could to facilitate the authorities at this crisis. This and other work which we are carrying out for the Government at Dundalk has kept our works busy.

In answer to a query raised by a shareholder, Mr. Fane Vernon explained that there is no arrangement between the Government and the Irish railway companies for the carriage of troops and stores, as there was in England. The Company had displaced its own regular traffic in order to facilitate the Government.

Sir William J. Goulding, Bart., Great Southern and Western Railway. Everything possible was done by their Company to assist and co-operate with the military authorities, regardless of all other considerations. During the past half-year, during the mobilisation of the Expeditionary Force from August 5th to August 21st, they carried in 172 special trains 60,000 men, 10,000 horses, 200 trucks of baggage, and 1,100 wagons of guns, etc., although they had received no guarantee of subsidies, as the English companies had had when taken over by the Government. They had turned out at their Inchicore Works for the War Office to December 31st, 1914, an ambulance train, and as soon as this had been completed an order was given by that Department for 90 general service transport wagons, and these had been delivered, in addition to supplying axles and brasses to other Irish railway companies, who received orders for similar wagons, and also 149 sets of axles, 116 sets of pipe boxes, 67 sets of wheels, 32 sets of draught poles, while they had an order now in hands for 45 water tank carts, 7,000 picket pegs, and 400 picket posts. I am glad to say, in answer to the

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query whether the Government had paid for the troop trains, that the Government were still paying 20s. in the £.

Viscount Churchill, Great Western Railway. To give you some idea of what our Company has done, I may mention that up to a few days ago no fewer than 6,684 special Military trains have had to be accommodated, carrying troops, horses, munitions of war, Admiralty coal, etc., apart from the great numbers of troops and materials conveyed by our ordinary trains. I should like, as Chairman of the Company, to take this opportunity of bearing testimony to the magnificent way in which all grades of our employés have risen to the occasion, and I wish to thank them—and I am sure you will join me in that expression—for their untiring zeal and devotion to their work, often during long hours and under most trying circumstances. I need hardly say that this applies with special force to our friend, Mr. Potter, our general manager, and to our other chief officers, who, since the war broke out, have had no cessation from the arduous and responsible duties which the emergencies of the situation have thrown upon them; and we are much indebted to them for the way in which they have, without stint, devoted themselves and their energies to the carrying on of the business of the Company.

There is another point which I think will be of interest to you, and that is that the Great Western Railway Company, in common with other railway companies, are assisting the Government in the manufacture, in their works at Swindon, of considerable quantities of Military stores and equipment. The companies have not sought to make profit for themselves out of this work, but have merely stipulated that arrears of repairs and renewals of railway works and plant, which have been brought about by the execution of Government work, should be recognised as creating a fair charge against the Government in the future. Services have also been rendered to the Admiralty in connection with the Company's steamboats. Without going into the details, I may mention that the three turbine steamers which were engaged on the Fishguard and Rosslare services were, at the commencement of the war, taken over by the Government as hospital ships, and I may say that they have also taken over four out of five boats on the Channel Islands service for various purposes.

Isle of Wight Railway. Being an island, and the principal connection with the mainland being *viâ* Portsmouth Harbour and Ryde, Isle of Wight traffic has been much handicapped by the precautionary measures which the Admiralty have adopted, which has much restricted the services in and out of Portsmouth Harbour.

Sir George Armytage, Bart., Lancashire and Yorkshire Railway. I may mention that, in addition to the service of transportation, the railway companies have given great assistance to the Government by placing their various manufacturing establishments at their disposal, and though it would not be politic to go into details, I may say that very large quantities of military stores and equipment have been turned out by the works of this Company.

Almost the whole of our steamers in the East Coast fleet are now, and have been for some time, engaged on Government service. Of those which are not so engaged two were at Hamburg at the outbreak of hostilities, and were not allowed to leave. They are still detained, and their crews are interned in a concentration camp near to Berlin. We are still maintaining the joint mail service between Fleetwood and Belfast, but here again our fleet has been depleted, owing to the fact that some of the boats have been taken for Government service. Our Drogheda and Liverpool steamers are running as usual. We consider both the above services are important in maintaining the food supplies to this country. The growth of the fishing industry at Fleetwood has been continuous and satisfactory, and has amply justified the efforts we have made to improve it not only at the Fleetwood Docks, but by added facilities for transmission to the inland markets, though at the moment a number of trawlers have been taken away by the Government which affects our most recent figures.

Sir Gilbert Claughton, Bart., London and North Western Railway. At the outbreak of the war the Company, like many of the other railway companies, immediately placed their works and resources at the disposal of the Government, and have assisted them to the fullest extent of their powers in the construction of ambulance trains, transport wagons, and in the manufacture of various articles required in connection with the war. Four of our largest steamers were requisitioned by the Government, and we have reason to know they have rendered, and are rendering, very useful services.

Mr. Hugh W. Drummond, London and South Western Railway. Up to December last our traffic department, in order to carry out the necessary moves required by the authorities, have had to make arrangements for the running of no less than 4,913 special trains; taking into account the running of the empty trains necessitated by the heavy movement, you get a total of nearly 15,000 special trains provided by us for the Naval and Military authorities, and this quite apart from the enormous number of soldiers and sailors whose conveyance we have had to arrange for in the ordinary train service, and also the large number of special trains that we had to run to the different camps with stores, provisions, etc. We have, as you know, quite a number of large permanent camps all over our system, and since the war began other numerous camps have been established. We have had to provide for the provisioning of all these enormous camps, and I think I am perfectly justified in saying that the work done by all railway companies in this country has been magnificent. Naturally, this railway, owing to its strategical position, and owing to the fact, as I have said, that there are so many large Military centres throughout its system, and especially owing to Southampton being by far the largest and most

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important base for the departure of troops and stores, has done more than any other railway in the country. I think I may say also that if the country was not prepared and equipped for war, the railways of the country were, at any rate, ready, and at once on the declaration of war, prepared to place all their enormous resources at the disposal of the Government. Certainly on this railway we have for many years been specially training our men to deal with large movements of troops, and in this connection our big Naval Reviews taught us a lot. These movements taught us how to undertake the transport of bodies of people, and it also gave us a true indication of the capacity of our line, and which has proved to be most useful to us during these last months. A specially interesting item, and one which I desire to bring to your notice, is that in every instance our trains have been waiting for the troops; we have never kept in one single instance the troops waiting for our trains. We have always been ready, and further than that our trains have always arrived at their destination at or before schedule time, and I think that this is a very fine record for all our officers concerned.

Of course, as a commercial port, Southampton has suffered enormously. The port has been practically closed since the commencement of the war, and I am sorry to say that, for the present anyhow, its trade has been diverted elsewhere. They have had an enormous task there, but it is one that has been carried out most efficiently and successfully by our energetic and capable docks manager, Mr. Williams, without a hitch of any single sort. It is a matter of gratification to us that the work done at Southampton by Mr. Williams has given the greatest satisfaction to all the Naval and Military authorities concerned, and he has received well-merited praise on all sides for what he has accomplished. While some of our ships have been commandeered for Government work, we have been, I am glad to say, left sufficient to carry on the majority of our cross-Channel services. These have been kept running to Havre and other ports across Channel conveying passengers, often to their full capacity, whilst services from other ports to the Continent have had to be abandoned. Happily, up to the present not one of our steamers had met with an enemy, or has been damaged in any way.

Now, I think that every railwayman, and I hope every railway shareholder, is agreed that the Government did the right thing in taking over the railways. It meant one control, and one management, and I think you will all agree with me that right well has the work been done. I think I am right in saying that when the railways were taken over the junior general manager of the railways of the country was selected to be the acting Chairman of the Committee, and we are all pleased that the Government has taken so early an opportunity of showing their appreciation of his services, and we all compliment him on the honour he has received.

Lord Bessborough, London, Brighton and South Coast Railway. As regards goods traffic, we have for the past few months been exceedingly busy; food and supplies for the large camps which have been established in places approximate to our railway have been carried in great quantities. Contractors have brought us an immense amount of timber and other supplies for these camps. In addition, we have conveyed, on behalf of the Government, stores and supplies amounting to nearly half a million tons. I have had particulars taken out of the special trains we have run on behalf of the Government, and find that up to the present date the total is over 4,400. I may mention that we have also carried a large quantity of materials and a great number of sailors and soldiers by our ordinary services. Our Continental services, *viâ* Dieppe, have naturally given us some anxiety. It is noteworthy, however, that until, in consequence of Government requirements we had to stop for two days in February, and with the exception of three days in November when mines were reported to be in proximity to the line of route, there have been daily sailings in both directions ever since the outbreak of war. In this connection it may interest you to know that our partners—the Chemins de Fer de l'Etat—have been able to maintain their train services to and from Paris during the whole period, and have rendered us every assistance in carrying on the Continental business. We have been unable to run the services *viâ* Newhaven as that port has been required for other purposes, but we have been accommodated by our neighbours, the South Eastern and Chatham Company, at Folkestone, and I would like to take this opportunity to express our thanks to them for the assistance they have rendered us in enabling us to perform these services with regularity. Our cargo boat services have had a precarious existence, and we have again to thank the South Eastern and Chatham Company, and also the South Western Company, for permitting us to run to Folkestone and Southampton alternately. The traffic at Southampton and Folkestone has now become so heavy that we are compelled to look out for some other port. Plans and estimates are under consideration, and we hope the work in some other port will soon be proceeded with.

In addition to transport services the companies have rendered considerable assistance to the Government. Special storage accommodation has been provided, sidings have been laid down and equipped with cranes and other necessary appliances, casual labour has been found, ambulance trains and general service wagons have been built, and military equipment of various kinds has been manufactured, whilst valuable services—by no means limited to the conveyance of troops and stores by the usual traffic routes—have been rendered by those companies owning steamships.

Lord Farrer, London Electric Railway. Your railways did not come under Government control, and, therefore, it became necessary on the outbreak of war for your directors to take very carefully into consideration, in concert with the other companies of our group, how we could from day to day best carry on business necessary

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for the convenience and indeed the livelihood of a large number of the citizens of London. Our first duty naturally was to give every support in our power to those in authority, and during the mobilisation, when the forces of the Crown were being moved across London in every direction, complete freedom of transport was given by your railways to soldiers and sailors.

Lord Aberconway, Metropolitan Railway. Since last August the "widened" lines have been used for no less than 2,738 troop trains; and when the first Expeditionary Force was being moved, we passed as many as 58 troop trains in one day over that section in addition to all the ordinary traffic. More recently, we have also had to use these lines very largely for goods relief purposes. Vast quantities of extra traffic have been thrown upon the trunk lines owing to the cessation of the coastwise shipping trade, and considerable congestion has ensued. During the first fortnight in February, for instance, we passed over our widened lines section no less than 2,935 goods trains, or equal to 210 per day, in addition to the special trains with troops and Government stores and the ordinary local passenger services morning and evening. Our Circle line, connecting as it does many of the main line termini, has also been extensively used for the conveyance of soldiers passing to and from the different camps, and many special trains have had to be run for the purpose on this and other sections of the line. The East London line, for the working of which we are now responsible, has also been largely requisitioned for Military purposes. A very large camp is under construction at Wendover on our northern extension line. We have already conveyed many thousands of tons of timber and other material for the construction and equipment of this camp, and there will very shortly be some very large movements of men backwards and forwards in connection with its use. Notwithstanding all this extra business, we have managed to keep our ordinary services running except on one or two days of exceptional pressure, and we have done this on a line that is normally one of the busiest in the country, and without any mishap of any kind.

Mr. G. Murray Smith, Midland Railway. No information is given as to the work that Mr. Fowler, Mr. Bain, and Mr. Worthington had done during the past year; but I can tell you that Mr. Fowler and Mr. Bain's shops have been working under high pressure during the last five months, not only in doing the work of the Company, but in assisting the War Office to complete work which it was found necessary and most important should be completed as rapidly as possible, and which private firms and the Government factories had difficulty in turning out speedily enough owing to the amount of work they have on hand. Mr. Worthington has also been busy in carrying out the extra work imposed on him by the war.

There is one fact in connection which I do not think is so generally recognised as it ought to be, and that is the men who are doing this good work on the railways are, in fact, taking their part in the war, and are materially helping the soldiers and sailors of our country, and of our Allies, to bring this war to a successful conclusion; for the railways are a link, and a very important link, in the chain of operations which are being carried out by the War Office and by the Admiralty; and so far I am thankful to say that the railway link has proved itself equal to the great strain put upon it. But I must tell you that the railways are working under very great stress and very great difficulties. For instance, we have lost about 12 per cent. of our staff, and there is a great shortage of labour all over the country. We are obliged to keep trains ready for the movements of troops, which necessitates the blocking of one of our running lines. Then our trucks are kept under load by the military authorities for an indefinite period, and there is a greater movement of material on the railway than there has ever been, even in our most prosperous of years, owing to the diversion of a large amount of coal and goods from the sea route to the railways. In spite of these difficulties, the companies are determined that all military requirements shall be as punctually carried out as they have hitherto been; but in view of the enormous numbers of soldiers—and all the material connected with an Army which have still to be moved—we may have to ask the indulgence of the trader and the public to make some allowance for any inconvenience they have suffered in the past, and will suffer in the future, owing to the special conditions under which the railways are working.

Mr. Spencer J. Portal, Midland and South Western Junction Railway. It may interest you to know that from August 5th to December 31st we ran 566 special troop trains, and conveyed during the same period 2,137 officers, 154,671 men, 22,291 horses, 74 guns, 1,102 wagons, 1,170 tons of baggage and 1,373 bicycles. In addition, we have had 53 special ambulance trains worked from the south to places north of Cheltenham, 10,000 trucks of Government stores have been conveyed to the ordnance depôt at Tidworth, and very large quantities of material for the hutments at Tidworth, Ludgershall and Chiseldon. For several months after the declaration of war we had 70,000 to 80,000 soldiers encamped at Tidworth and Ludgershall. The Government are constructing permanent cavalry barracks at Draycott situated near to our line between Ogbourne and Chiseldon stations, and connected by rail with the latter station, to which place we are, at the cost of the War Office, building two miles of railway.

Major Cusack, Midland Great Western Railway. At the request of the military authorities they undertook to build in their wagon shops 42 general service wagons, and 3,500 picketing pegs and picket posts.

Lord Rathmore, North London Railway. The ordinary working of our line has been very much interrupted by the exigencies of the Government requirements. Owing no doubt to its being a connecting link between so many of the trunk

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lines very great use has been made of it for the conveyance of troops and war equipment, so much so that on a number of days it was necessary to suspend all ordinary traffic, which could not be done, of course, without causing the greatest inconvenience to our regular passengers, which we much regret. But in order to mitigate this as far as possible, we were able some time ago to make arrangements with the Metropolitan and Metropolitan District Railways that when the ordinary service of passenger trains is suspended the season tickets issued by this Company will be accepted by the two railways I have mentioned. It is satisfactory to know that the very large volume of Government traffic which has passed over our line since the war began has been dealt with without a hitch, and that reflects the very highest credit upon our staff, who, from the highest to the lowest, have worked with the utmost zeal and energy.

Mr. Tonman Mosley, North Staffordshire Railway. Since August 4th they had carried, exclusive of probably another 20,000 men who had passed over their lines from beyond North Staffordshire, from 48,000 to 50,000 men and 2,860 horses all free to the Government and without a single scratch. The Government had also had continuous use of twenty carriage trucks belonging to them.

Mr. H. Cosmo Bonsor, South Eastern and Chatham Railway. The Executive Committee have had great responsibilities thrown upon them, and the work they have done has been extraordinary. During the first week or 10 days not a single body of troops waited for a train. The train was always ready to wait for the troops, and the trains when they started always ran up to the schedule of time. Now, that would not have been possible had there not been great inconvenience caused to several passengers. At one time on our system it almost looked as if we should have to suspend the passenger traffic. Happily we were able with a restricted service to carry out the business of our Company. Very heavy responsibilities have been thrown upon individuals, and I ought here to mention that our General Manager, Mr. Dent, owing to the fact of our close connection with the foreign railways, the Chemin de Fer du Nord and the Belgian State lines, has had special responsibilities thrown on him. The Government at once took over the ports of Dover and Newhaven, and the Ostend, the Calais, and the Dieppe services, in addition to those already existing between Boulogne and Flushing, had to be moved to Folkestone. You will remember that at the time of the competition between the South Eastern and Chatham Companies the South Eastern Company had commenced the improvements at Folkestone Harbour. When the Managing Committee took over the harbour they considered that those works should proceed and be completed, and I may say that it is extremely fortunate for all our interests that that was done. Folkestone Harbour has proved a great national asset at the time of this emergency.

Now, when Germany began to invade Belgium an arrangement was made by the Local Government Board that we should put on an additional service between Folkestone and Ostend, and as Germany gradually occupied the whole of Northern Belgium, a great demand came upon us for additional boats to carry the war refugees from Belgium to this country. The Admiralty one day requested that every available boat should be sent to Ostend, and one day alone we on our boats landed over 6,000 war refugees at Folkestone. I must say that the War Refugees Committee and the local branch at Folkestone did good service; and I may also add that both our marine department and our traffic department did loyal service for these unfortunate refugees. I did allude, in a passing way, to the good services of our marine department; but the Admiralty took over at once the great majority of our boats. We managed, however, to carry on a continuous cross-Channel service, and a great number of special services at the instigation of the Government. I cannot help alluding to the fact that our boat, the *Invicta*, was very instrumental in saving some of the survivors of His Majesty's ship *Hermes*, and that *The Queen* saved—what I believe is quite a record—2,200 panic-stricken refugees from the *Amiral Gauteaume*. Capt. Carey, his officers, and men were all thanked. Capt. Carey was specially thanked by His Majesty the King, and the whole of them were thanked by the Belgian and the French Governments and by our own Government. A duty we undertook was in regard to the Belgian State Railway officers. We are in close connection, naturally, with the Belgian railways, and we offered them our hospitality. We have been able to give them board and lodging, and to do something to relieve the terrible state in which otherwise they would have found themselves. Dover marine station is in a very forward condition, and probably we should have been considering opening it immediately had not the war come. As it is, we are using it now as a landing stage for the wounded, and every facility we can give to assist our own wounded coming back to this country has been given at Dover and will be given.

Mr. Charles J. Cater Scott, London General Omnibus Company. I can give you some idea of the diversified character of the services rendered to the Government by your Company; it includes not only the supply of omnibuses and motor lorries in large numbers; the use of some of our garages for various purposes; the use of the Company's shops; the use of our splendid training school at Chelsea for training drivers for motor transport abroad, and, in addition, perhaps the most important is the provision of about 2,000 men who are engaged as drivers of motors abroad, in addition to whom 2,500 employés have gone for war service, representing together 4,500 employés of the Company, or approximately 25 per cent. of its staff.

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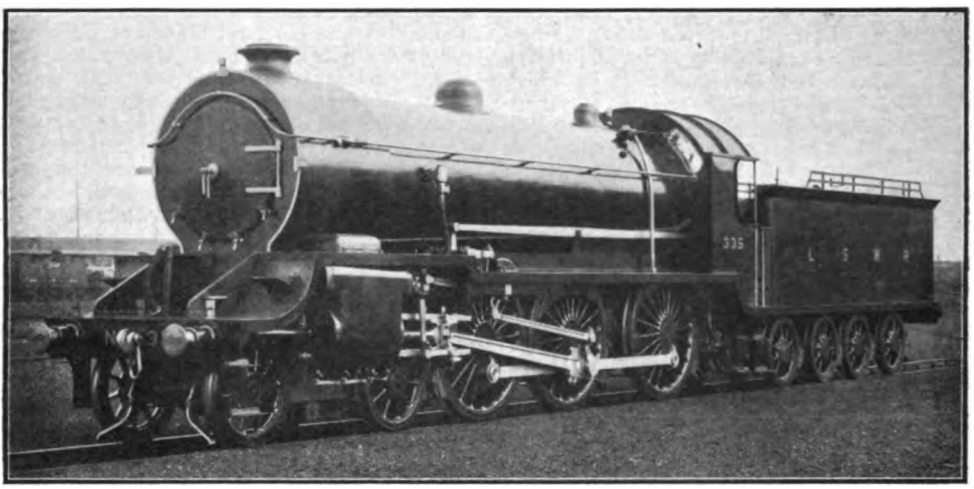
AN INTERESTING LOCOMOTIVE RECONSTRUCTION ON THE LONDON AND SOUTH WESTERN RAILWAY.



NO. 335 (ORIGINALLY BUILT BY MR. D. DRUMMOND), AS REBUILT BY MR. R. W. URIE.

MR. R. W. URIE, Chief Mechanical Engineer, London and South Western Railway, has rebuilt one of the late Mr. Dugald Drummond's earlier 4–6–0 four-cylinder engines, to accord substantially with his own mixed-traffic locomotives of the 486 class. As will be seen from the illustration given herewith, many important changes have been made, but the original boiler, minus the firebox water tubes, is retained. There are, however, new cylinder dimensions and other vital changes, while the engine now has only two cylinders instead of four. In addition, the position of the outside cylinders is altered, the valve gear is inverted from its old arrangement, and the exterior frame plating and running board introduce other important changes. In the new form No. 335 is fitted with Mr. Urie's "Eastleigh" superheater, as illustrated and described last month. There are twenty-four elements placed in smoke-tubes, 5¼ in. external diameter. Fittings include hot water injectors, sight feed lubricator, vacuum brake on tender, etc. No. 335 will take its place with the 486 series on both heavy goods and passenger traffic.

As a matter of interest, we give the leading dimensions of No. 335 in its present form, together with those which originally applied :—

	Original dimensions.	As rebuilt.
Cylinders .. .. inches	16½ × 26 (4)	21 × 28
Coupled wheels (dia. on tread) .. .. ft. in.	6 0	6 0
Working pressure, lbs. per sq. in.	175	175
Heating surface—		
Small flue tubes .. sq. ft.	2,210	1,252
Large ,, ,, .. ,,	—	464
Water tubes in firebox ,,	357	—
Firebox .. .. ,,	160	168
Superheater	—	308
Total .. .. ,,	2,727	2,192
Grate area .. .. ,,	31·5	31·5
	T. C.	T. C.
Weight of engine in working order	76 13	79 12
Weight of tender in working order	49 0	49 0
Total Weight	125 13	128 12

Owing to extreme pressure upon space this month the concluding London and North Western instalment of Mr. E. L. Ahron's articles on "Locomotive and Train Working in the latter part of the 19th Century" is unavoidably held over.

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Railway Literature.

RAILWAY YEAR BOOK. [366 pages. Cloth. Price 2s. 6d. net. Post free in British Isles, 2s. 10d.; abroad, 3s.]

Appearing now as the eighteenth annual issue, the 1915 "Railway Year Book" includes a number of items of special interest. It contains virtually all usual features, with several special sections of peculiar interest while our country is engaged in war operations. Essential facts are given concerning the taking over of most of the railways of Great Britain by the Government and their direction under the Railway Executive Committee, together with the latest available statistics as to numbers of railwaymen now with the Colours. A list of ambulance trains equipped by various railways is also presented.

The fact that most railways are now under the direction of the Railway Executive Committee, and that arrangements for remuneration by the Government are on a special basis, precludes statistical information usually available being given on this occasion. In their place, however, several special tables relating to 1914, and therefore more up-to-date, are now presented. Thus, statistics of track mileage are given in a new and improved form, while other special tables give detailed statistics of steam locomotives and rolling stock, electric rolling stock and rail motor cars. Several other tables are given in a new form.

In regard to the usual features, all sections have been revised as required, and in many places amplified, while a large number of additional biographies are included in the "Who's Who" section. In the aggregate the changes and improvements made in this edition continue to justify the claim of the "Railway Year Book" to be regarded as the "Whitaker of the Railway World."

* * *

MODERN BRITISH PERMANENT WAY. By Cecil J. Allen. [*The Railway News*. Price 6s. net.] Written by our well-known contributor, Mr. Cecil J. Allen, this book embodies a reprint of a series of articles which appeared in *The Railway News* at various periods between 1911 and 1914. The subject matter has, however, been completely recast and materially added to in order to bring the information up-to-date. Although a number of treatises descriptive of the laying and maintenance of permanent way have from time to time been published, it is claimed this book constitutes the first attempt to deal comprehensively with the principles underlying the design of the various details of which the track is composed, and to describe their manufacture. As the author remarks in the preface, it is intended more especially for the use, as a work of reference, of those engaged in the design of permanent way, and the drawing up of specifications, who are but imperfectly acquainted with the possibilities and limitations of manufacture.

The first three chapters deal with steel rails, and go exhaustively into the history and development of modern rail sections, the chemical composition of rail steel, and the rolling and inspection of rails. Chapters IV. and V. are devoted to fishplates and fishbolts; Chapters VI. and VII. to the design and manufacture of cast-iron chairs; and Chapters VIII. and IX. to chair keys and fastenings. In Chapters X. and XI. the selection of timber for sleepers and their preparation and preservative treatment are gone into thoroughly, while Chapter XII. deals with ballast. Chapter XIII. is occupied with description of rail-joints, creep, and the spacing of sleepers. The second half of the book is devoted to switches and crossings, of which numerous types are illustrated and described. Chapters XIV. and XV. deal with switches, Chapter XVI. with three-throw switches, and Chapters XVII., XVIII. and XIX. with crossings. In Chapter XX. some modern examples of slip road and scissors crossing construction are given, while Chapter XXI. is devoted to manganese steel points and crossings.

In every chapter numerous illustrations are given of the divergent practice of British railway companies, the line drawings numbering 150. The size of the book is 10 in. by 8 in. These drawings are supplemented by fifty photographs illustrating the various processes of manufacture.

* * *

THE LOCOMOTIVE ENGINEERS' POCKET-BOOK AND DIARY, 1915. [Locomotive Publishing Co., Ltd. Price 2s. 6d. net]. This useful pocket-book and diary as issued for 1915 retains all usual characteristics, and includes a number of interesting reference articles, together with tables, formulæ, lists of dimensions, and diagrams and illustrations of notable locomotives, besides various practical sections. There is also a directory of locomotive officers on principal railways, while in addition to the diary are memoranda and squared pages for notes and sketches.

* * *

THE PRACTICAL ENGINEER POCKET BOOK AND DIARY, 1915 (MECHANICAL); THE PRACTICAL ENGINEER ELECTRICAL POCKET BOOK AND DIARY, 1915. [The Technical Publishing Co., Ltd. Prices: Peltine binding, 1s. 9d. per copy,

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post free ; cloth binding, 1s. 3d. per copy, post free.]

These useful pocket books and diaries can be commended within their scope. In the former the general idea of classifying the various matters dealt with so as to devote complete sections to separate subjects has been further proceeded with, the result being a more full and connected summary of essentials in a limited space than would otherwise be possible. Each section has been carefully revised to bring its contents up to date, whilst omitting such matter as is better dealt with by ordinary text-books. A carefully selected list of such books bearing on the subject dealt with follows each section.

In the electrical pocket book numerous additions have been made, more especially in connection with electric motors, fuses, and wireless telegraphy. The Section on Laws and Official Rules has been carefully brought up to date, and is believed to be the fullest of its kind published. Furthermore, the lists of books dealing with the subjects in the several sections, which were introduced last year, have been revised and added to.

New Great Northern Railway Appointments.

MR. J. E. ABBOTT.

MR. A. LAMB.

AS announced last month, Messrs. J. E. Abbott and A. Lamb have been appointed Assistants to Mr. C. J. Selway, Superintendent of the Line, Great Northern Railway. We have pleasure in reproducing portraits of both these gentlemen. Mr. Abbott's duties lie in the control of the working of the passenger, goods and mineral traffic, and those of Mr. Lamb, in matters of staff, special traffics, rules and regulations and the general commercial business of the department.

Mr. Abbott entered the service of the company in 1885 and was for 10 years in the mineral and goods sections of the Accountant's Department and in the Claims Office of the Superintendent of the Line. In 1892 he entered the Train Department, became chief of the goods train section in 1895, and combined the duties of that office with the control of the Passenger Train Office in 1907. During the last 15 years he has had exceptional opportunities of acquiring experience in the working of trains and traffic of all descriptions.

Mr. Lamb entered Great Northern service in 1891 at Nottingham, and after experience in various capacities at Colwick, Shepreth and Royston he joined the staff of the Superintendent of the Line at King's Cross, in 1897, where he spent two years in the Train and Excursion Offices. From 1899 to 1908 he acted as relief stationmaster, gaining experience invaluable to his present position. In 1908 he returned to the Superintendent's Office, taking charge of the excursion section, which office he held until 1913, when he was appointed chief of the special traffic section, an office which has come into special prominence since the outbreak of the war.

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PERTINENT PARAGRAPHS

The War and Transport Difficulties.

SPEAKING in the House of Commons on February 16th, in the course of a debate on the prices of the necessaries of life, the President of the Board of Trade said: "There is no doubt that the reason why household coal has gone up so largely in price in London is due—I will not say entirely, but in large part—to the difficulties of bringing it here by rail. Coal that comes here is mainly used by the gas and electricity works for great factories and companies like the Underground Railway, which raise a large amount of electric power. We, at once, realising that the rail-borne coal dominated the household market, felt bound to go into the way in which the railways were dealing with rail-borne coal. We found that their facilities had been very largely diminished. I need not tell the House how many trucks are naturally held up for Government purposes. It is of the very first importance that the Navy should have its coal whenever and wherever it wants it. It is also true that a very large amount of rolling stock must be kept vacant waiting for the transport of troops in one direction or another, and that has certainly tended to railway congestion. Owing, however, to the efforts which have been made by the Railway Executive Committee, the import of coal into London has been better. . . .

Pooling of Railway Wagons.

"THE pooling of railway trucks," continued Mr. Runciman, "has relieved the congestion of coal traffic and the port traffic by the transfer from one railway which had rather too many trucks at liberty to another which had rather too few for use. To that extent there has been pooling; but pooling in the same sense of utterly ignoring the railways from which the railway trucks come would only lead to confusion. The railway companies have had to alter their method of dealing with their traffic to this extent, but they are now endeavouring to, and succeeding, in assisting other companies which are working at high pressure. Moreover, again and again traffic has been diverted on to another line or another railway system, so that there might be not the least delay. The Prime Minister last week made a reference to a fact that payment for demurrage of wagons had been experimentally suspended. What he meant by that was, no doubt, demurrage as to railway companies. It would not do to suspend the payment of demurrage by ordinary traders, otherwise we should rapidly find wagons would be used for warehouse purposes, and the shortage which we have at the present time would be accentuated. To that extent we have adopted the principle of pooling.

State Control of Railways and of Shipping Compared.

MR. RUNCIMAN stated that he would not hesitate to embark on the State control of ships if he thought it would lead to national advantage, but in his opinion no analogy can be drawn between the railway companies and ships. "In the first place, the railways are entirely within our islands. They are not subject to foreign competition. They are at the present moment controlled by a very small body of men, and one of the successes of the war—if one can speak of success in such a connection—has been the skill with which the general managers sitting in one room round one table, have co-ordinated their services. That has been due to the fact, not that the Government undertook the management of the railways, but that it brought together those who controlled the railways and allowed them to go on managing them. The next characteristic of Government control over railways has been that, although we have control over the railways, we are not managing them. We are not interfering with their rates; we are not coming between them and merchants of various kinds, wholesale or retail. We are not stepping in to decide how they shall send down their trucks to one colliery or another, or north, south, east or west. We are leaving that entirely to the management, which knows far more about these things than any of us in this House."

Interchange of Railway Wagons.

IN the same debate, Mr. Runciman said: "I am informed by the Railway Executive Committee that arrangements have been made enabling assistance to be given by companies having a surplus of wagons to those experiencing a shortage. It has also been arranged that wagons belonging to one company which have been worked on to the line of another may be loaded back locally in the home direction, instead of being returned empty, and the question of extending this practice to wagons in docks is under consideration. This arrangement, in so far as it has gone, applies to Scotland as well as England. The question of private wagons is much more difficult owing to their different shapes, sizes, and conditions, but I am informed

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by the Railway Executive Committee that no relief would be obtained by pooling private wagons as well as company wagons. . . . There are some sidings which are occupied by coal, kept there for naval purposes, and which must of necessity be kept there."

In the House of Commons, on Monday, February 15th, Mr. Churchill stated that the Admiralty have requisitioned more than one-half of the hundred steamers of over 250 tons, and of the 117 under 250 tons owned by the railway companies.

A War Bonus for Railwaymen.

THERE has recently been a good deal of discussion in regard to increased cost of living due to advanced prices of food stuffs, etc. This matter has formed the subject of a conference between a committee of General Managers of the principal railways in England and Wales and representatives of the men, with whom negotiations for a revision of the Conciliation Scheme were in hand when the war broke out.

As the outcome of this conference an agreement was arrived at embodying the following terms :—

This agreement to apply to all wage-earning employés of eighteen years of age or upwards in the grades "engaged in the manipulation of traffic."

A bonus of 3s. per week to be paid to all employés available for duty whose standard rate of wage is under 30s., and 2s. per week to employés whose standard rate of wage is 30s. or more, the first payment to be made in respect of the week commencing February 15th.

The arrangement to remain in force during the continuance of the Agreement between the Government and the railway companies, but to be subject to review at the end of three months ; and that whenever the Government gives notice to determine that Agreement the railways will give not less than two weeks' notice to terminate the arrangement.

Although the terms of the agreement confine the arrangement to men embraced in the proposed revised Conciliation Scheme, virtually all companies have extended it to other grades. At first several English and the Scottish and Irish companies did not accede, but within a few days practically all companies came into line, though as the Irish railways are not under the Railway Executive Committee it appears that, unless other arrangements are made, the whole cost would come directly upon them.

As to the cost of this the *Railway News* comments as follows :—Confining our calculations to England and Wales, it will be seen that there are 274,045 men in Conciliation grades and 236,449 in non-Conciliation grades, a total of 510,494 adults. We believe it would be a fairly correct assumption to say that one-quarter of these would be in receipt of 30s. per week, and upwards, and, on that basis, the annual cost of an all-round bonus of 3s. to men under 30s. and 2s. to those in receipt of 30s. per week or more would be £3,650,031.

The Lancashire and Yorkshire Railway Roll of Honour.

MEMBERS of the staff from every department on the Lancashire and Yorkshire Railway Company's system have joined the Forces, and on February 13th no less than 4,189 men were serving with the Colours, of which 362 are members of the salaried and clerical staff, and 3,827 of the weekly wages staff. The Railway Transport Section is represented by five officers and thirty N.C.O.'s and men ; whilst one officer and 41 men are connected with the Royal Engineers (railway troops). One officer and 47 men are also engaged with the Army Service Corps (labour section). Forty-three of the men have been killed in action or subsequently died of wounds and other causes. Two members of the staff of the Lancashire and Yorkshire Railway serving with the Forces have received recognition for special services. Lieutenant E. C. Simpson has been awarded the Military Cross for services rendered in connection with the railway transport establishment in France, and Inspector Walch, of Bolton, has been awarded the Royal Naval Distinguished Service Medal in connection with ambulance work at Antwerp, this being the first case of a member of an Ambulance Corps receiving such a distinction. The company have issued Rolls of Honour which, in addition to giving the names of the men and the nature of their employment in the railway service, show the regimental number and the name of the regiment or ship to which the men are attached. The Rolls of Honour, which consist of an ornamental card in colours, are framed and glazed, and are exhibited in prominent positions at almost every station on the system, one station being represented by five frames containing a total of 401 names.

A specimen of the Roll of Honour is illustrated on page 312. In addition, a number of these Rolls of Honour are being exhibited at principal stations, on large notice boards, surrounded by recruiting bills, and this forms a very attractive and useful advertisement.

Special Railway Traffic Arrangements.

NOTICES issued by various railway companies show that extensive reductions in the passenger services are being made. This was only to be expected, partly because of military requirements, and also with a view to facilitating goods traffic in the interests of the country as a whole. There are, however, good facilities still remaining, and in view of the reduced general travelling which necessarily now takes place, and the fact that if one train is taken off there is usually at least an approximately equivalent facility remaining or provided in place, the ordinary traveller has little to complain of, and is by no means inadequately served.

Great Eastern train reductions have already been referred to. On the Great Central Railway several of the cross-country trains are withdrawn,

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either entirely or over portions of their routes for the time being, and reductions on various routes, usually of certain more or less special trains which can hardly justify themselves altogether under present circumstances. Some of the Sheffield-King's Cross trains are withdrawn or altered, including the 4.50 p.m. up from Sheffield and the 6.5 p.m. down from King's Cross. The 3.15 p.m. "Sheffield Special" now calls at Leicester at 5.4 p.m. (its old "slip" time, 109 min. for 103 miles), and at Nottingham at 5.30 p.m. A number of suburban trains in the London, Manchester, and other districts are also withdrawn.

East Coast Modifications.

On the East Coast lines, among important trains withdrawn are the 7.45 a.m. from Edinburgh to Newcastle, 4 p.m. Newcastle to Berwick, 7.28 p.m. Berwick to Edinburgh; 8.43 a.m. Newcastle to Leeds and 7.10 p.m. Leeds to Newcastle; 10.23 a.m. Great Central train York to Bournemouth; 12.33 and 6.24 p.m. Great Central trains between Sheffield and York, and 2.55 p.m. York to Sheffield; 6.35 p.m. Midland train York to Sheffield and 6.37 p.m. Sheffield to York; 2.14 p.m. Great Northern train from Doncaster to York and 4.10 p.m. York to Doncaster; also trains between Harrogate and Leeds, Harrogate and Doncaster (Great Northern trains), Hull and Doncaster (Great Central trains), and Hull and Goole (Lancashire and Yorkshire trains). A number of compensating alterations are made. Through carriages are withdrawn between King's Cross and Perth, Saltburn (7.35 a.m. up and 5.30 p.m. down), York (1.40 p.m. down), Newcastle (6.5 p.m. down); between Liverpool and York (Lancashire and Yorkshire route, 2.55 p.m. from Liverpool and 4.25 p.m. from York); and between St. Pancras and Harrogate (4.55 p.m. down and 9.40 up). Sleeping cars are withdrawn to and from Perth, and restaurant cars from the 9.40 a.m. from Ripon, 9.43 a.m. from Hull, and 1.40 and 6.5 p.m. from King's Cross, also between York and Berwick on the 3.30 p.m. from York, and on the Liverpool-Newcastle services, 10.40 a.m. and 6.40 p.m. (Lancashire and Yorkshire), and 5 p.m. (London and North Western) from Liverpool, and 12.30 and 4.50 p.m. (Lancashire and Yorkshire) from Newcastle. The London and North Western dining car is, however, run instead on the 6 p.m. from Liverpool.

Great Northern Alterations.

Great Northern alterations involve the withdrawal of trains from King's Cross at 10.35 a.m. to York, Newcastle, and Edinburgh; 11.10 a.m. to Cambridge; 12.30 p.m. to Sheffield, Doncaster, etc.; 1.40 p.m. to Harrogate, etc. (the 1.30 p.m. is altered somewhat to compensate); 3.25 p.m. to York, Halifax, etc. (part of its work is given to the 4 p.m.); 6.5 p.m. to Sheffield (Hull carriages attached to 5.45 p.m. express); and the corresponding trains, including the 7.50 a.m. and 2 p.m. from Leeds, 10.20 a.m. from Edinburgh, etc. Breakfast cars are run on the 7.3 a.m. from Leeds instead of the 7.50 a.m. Through carriages are withdrawn to Halifax (5.45 p.m. down), Horncastle (4 p.m.), Huddersfield (1.30 and 5.45 p.m.), Lincoln (4 p.m.), Manchester (1.40 p.m.), Nottingham (5.30 p.m.), Saltburn (5.30 p.m.), Sheffield (4 p.m.), York (1.40 p.m.), and Perth (10 a.m., 8 and 11.30 p.m.), and the return services. Sleeping cars do not run on the 11.30 p.m. to Perth and the 9.15 p.m. from Perth.

Euston Announcements.

London and North Western train alterations for March include the withdrawal of the 8.40 a.m. from Euston to Birmingham, etc.; 4 p.m. Euston to Manchester *vid* North Staffordshire Railway; 5.50 p.m. Euston to Birmingham, etc.; 7.30 p.m. Euston to Chester; 8.30 a.m. Birmingham to Manchester and Liverpool; 10.55 a.m. Preston to Carlisle; 1.17 p.m. Crewe to Carlisle (through carriages, Birmingham to Edinburgh and Glasgow, and Bristol and Glasgow are discontinued, but connections are given with the 1.12 p.m. from Crewe); 3 p.m. Manchester and 3.15 p.m. Liverpool to Carlisle, etc. (connections are given in place of this); 8.20 a.m. Birmingham to Broad Street; 8.10 p.m. Birmingham to Euston; 8.40 a.m. Manchester to Birmingham; 8.30 a.m. Windermere to Manchester and Liverpool; 10 a.m. Liverpool to Birmingham; 9.45 a.m. Manchester to Euston; the "Sunny South Special" both ways; 12.10 p.m. Carlisle to Crewe; 4.35 p.m. Manchester to Birmingham; 4.30 p.m. Liverpool to Birmingham; 11.42 p.m. Carlisle to Euston; also several London suburban trains, and various trains in the Birmingham and other districts. In partial replacement of these facilities, a number of new trains and alterations of others are introduced. Plank Lane station, on the Tyldesley-Wigan route, is closed for passenger traffic.

Alternative Route and Special Facilities.

In a number of instances tickets were made available over alternative routes, and the following announcements are typical of the arrangements made:

Until further notice tickets (ordinary, tourist, season, traders (for through journeys only), Saturday to Monday, and week-end) will be available as under, irrespective of the route by which the ticket is issued, it being understood that any existing arrangements for inter-availability of tickets will continue:

Between London and Birmingham and London and Wolverhampton: By any train of the London and North Western and Great Western Companies.

Between Liverpool and Manchester: By any train of the London and North Western, Lancashire and Yorkshire, and Cheshire Lines Committee.

Tickets by Midland route from stations in England to stations in Scotland (including Carlisle): By 2 p.m. from Euston and 2.20 p.m. from King's Cross.

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Tickets by Midland route from stations in Scotland (including Carlisle) to stations in England: By 2 p.m. from Glasgow (Central), 2 p.m. from Edinburgh (Princes Street), 2.20 p.m. from Edinburgh (Waverley) *viâ* East Coast route.

Tickets by West Coast route (Caledonian and London and North Western Railways) from stations in Scotland to stations in England: By 7.45 p.m. from Edinburgh (Waverley) *viâ* East Coast route, 10 p.m. from Edinburgh (Waverley) *viâ* Midland route, 9.30 p.m. from Glasgow (St. Enoch's), 9.35 p.m. from Glasgow (Queen Street).

By East Coast route from London and south thereof to stations in Scotland: By the 11.30 a.m. from St. Pancras.

By East Coast route from stations in Scotland to London and beyond: By the 11.30 a.m. from Edinburgh (Waverley) to St. Pancras.

By Midland route from stations in England to stations in Scotland: By the 2 p.m. from Euston and the 2.20 p.m. from King's Cross.

By Midland route from stations in Scotland to stations in England: By the 2 p.m. from Glasgow (Central), and 2 p.m. from Edinburgh (Princes Street), also the 2.20 p.m. from Edinburgh (Waverley) *viâ* East Coast route.

By West Coast route from stations in Scotland to stations in England: By the 9.30 p.m. from Glasgow (St. Enoch's), 9.35 p.m. from Glasgow (Queen Street), 10 p.m. from Edinburgh (Waverley) *viâ* Midland route, 7.45 p.m. from Edinburgh (Waverley) *viâ* East Coast route.

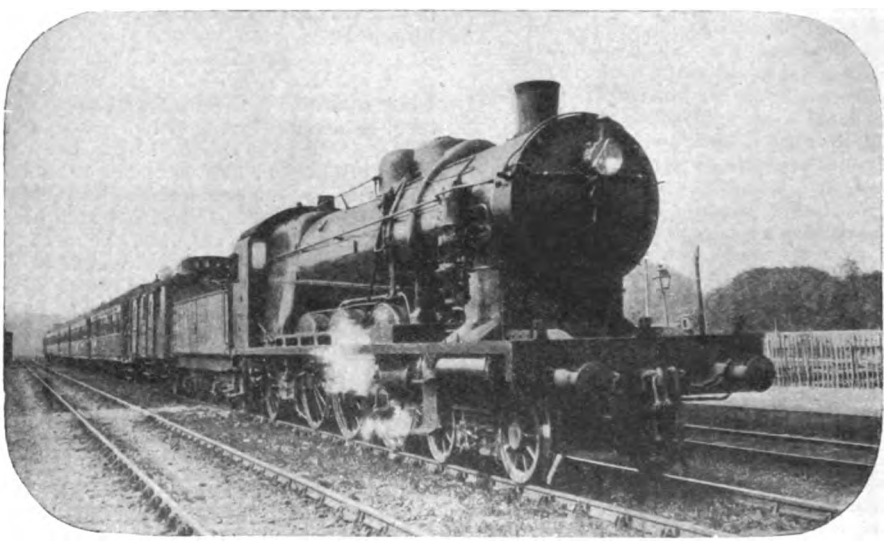
By Great Northern route from Sheffield to London: By the Midland 5 p.m. train, due St. Pancras 8.15 p.m.

Arrangements are also in operation for the inter-availability of tickets by the Great Northern, Great Central, and Great Eastern routes to and from London.

On virtually all lines notices were issued that until further notice day and half-day excursion bookings and certain other cheap facilities will be cancelled.

For some time the Continental services *viâ* Folkestone have been operated only by night trains from London, but certain day services have now been reinstituted.

The North Eastern Railway announces that owing to circumstances arising out of the war and the consequent curtailment of train services, the usual April issues of the large and pocket editions of the North Eastern Railway time table book will not take place. The services shown in the North Eastern Railway time table book will therefore continue in operation until further notice, revised according to the alteration or withdrawal pamphlets issued from time to time as circumstances render necessary.



Photo] [*W. H. C. Kelland.*

OUEST ETAT RAILWAY: FRANCE.

4-6-2 locomotive on express passing Poissy.

With the Forces in India.

WE are indebted to Mr. John Wardle, Commercial Manager, Metropolitan Railway, for a copy of the following letter received from Private W. E. Cooper, "G" Company, 10th Middlesex (D.C.O.) Regiment, formerly in the Metropolitan Railway service and now serving in India. Private Cooper writes; "You will, no doubt, be surprised to hear from me from Calcutta. Our regiment is out here completing training and at the same time relieving the regulars stationed here—the 2nd Royal Fusiliers, who leave to-day for England prior to going to the Front—and we arrived here on Friday last, December 4th, having been travelling since October 29th, which was the date we left Sittingbourne. We had a

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pleasant voyage out and fine weather. Altogether there were ten transport ships in our convoy, and for the greater part of the time we had an escort (of either one or two warships), which we picked up at various points. We were detained at Suez for over a week owing to trouble in the Red Sea, and here we went ashore one day for a route march, but there was not a great deal to see. We had a stop of three days at Aden, where we had the pleasure of seeing the *Sydney* directly after she had sunk the *Emden*. We gave her a good reception as she entered the harbour with the Australian convoy.

On the Indian Railways.

"We arrived at Bombay," continues this interesting letter, "on Tuesday, December 1st, and entrained the same day. We were loaded into long cars—three compartments to a car—and 15 men occupied each compartment. We had plenty of room until it came to sleeping, but we managed it fairly well by some of us sleeping on the floor. We were lucky enough to secure two blankets apiece, for which we were very glad, as the nights are bitterly cold in India. I made my bed under one of the seats next to the partition of the compartment and slept soundly until about 4 a.m., when I awoke, finding that I had been invaded by a swarm of ants. They found their way into my kit-bag and equipment, and I had rather a job to get rid of them. Several of my comrades suffered similarly, and we had a good look round in the morning and cleared them out with water. I forgot to mention that the name of the railway company is the Great Indian Peninsula. They have a splendid permanent way. Black labour is very cheap, and it is due to this that they are able to keep it in such perfect condition. A good deal of the distance is single line, and consequently we had several stops at certain points to allow mail trains to pass. There are few signal boxes, the levers being mounted on a platform and worked by natives. The tablet system for single line working seems general. We passed through some quaint little stations, and the scenery is magnificent for most part of the way, but the journey becomes very tiring after the first two days.

"Calcutta is a fine town, and the Fort is only just outside, so that we can walk into the town in about half-an-hour. We may not be in India very long, but I think that so long as we can keep in good health we shall enjoy the stay very much. Of course, fever is the great curse here. At present the climate is ideal, but this is their winter, and the summer is terrifically hot. I am going up country with "G" Company tomorrow for about six weeks to a station in the jungle. We are relieving the Royal Garrison Artillery who are there. I trust that everything is going on all right with the "Met.," although the war is bound to affect receipts."

Convoying Belgian Refugees.

ONE of our old readers, Mr. E. A. Gurney-Smith, sends along an exceptionally interesting letter, as follows. "This war has brought me some interesting experiences, and you may like to briefly hear of them. I am registered as Motor Cyclist Despatch Rider to the Red Cross, Kent V.A.Ds. But in addition to tearing all over Kent on my motor cycle, I have also been employed, owing to my amateur knowledge of railways (largely taught me by the RAILWAY MAGAZINE) and my possession of some French, to take under my sole charge some of the Belgian wounded soldiers about the country by railway. This was, of course, several months ago, when the Germans were advancing and the wounded in hospitals at Antwerp and Ostend were brought over to Kent. On one day I had to take 23 wounded Belgian soldiers to Abergavenny. I had to meet them at Victoria and take charge there. The Underground officials were most good in providing police to help me and in reserving a special car on an Inner Circle train to Praed Street. The Great Western Railway obligingly put on a special bogie corridor coach which gave enough room for the men to lie down and ran it through to Abergavenny specially, *vid* Worcester and Hereford. I returned alone the next day *vid* the Severn Tunnel. The next day I had to take 19 more Belgian wounded from Tonbridge, Sevenoaks and Chislehurst to Bedale in Yorkshire. They were mostly rather badly wounded. This journey involved a lot of telephoning from my home here to the special traffic departments of the South Eastern and Chatham Railway and Great Northern Railway, with the result that the South Eastern and Chatham Railway provided a very fine bogie saloon on a train which stopped at Tonbridge, Sevenoaks and Chislehurst. On arrival at Cannon Street a Great Northern Railway tank engine awaited us and took us round to King's Cross, where we were attached to the 1.40 express to the North. We arrived at Bedale, in the West Riding of Yorkshire, as a special train, but whether this was from York or only from Northallerton, I do not know. I had, of course, to make all arrangements for provisioning on both journeys. In this I was most splendidly helped by the ladies of the Marylebone detachment of the Red Cross (who are running the Red Cross refreshment room at Victoria). On the second journey they met us at Cannon Street and journeyed with us to King's Cross, having brought soup, coffee, a spirit stove, and a huge basket of provisions; and they arranged with the dining-car staff to heat up more soup for us *en route* and bring it to us at certain stations, as our saloon was not corridor.

"In addition to this, I have made several journeys to Folkestone Harbour in charge of numbers of recovered Belgians returning to the Front. The South Eastern and Chatham Railway Company, in the absence of any train between Bromley and Folkestone, kindly stopped Folkestone expresses at Chislehurst.

"Now I have just returned from France, where I have been on work other than that of the Red Cross. At a certain place in Normandy, one day last week I saw in a siding *hundreds* of Belgian State Railway locomotives

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of all types, rescued from the Germans. I travelled several hundred miles in France, almost invariably in splendid bogie corridor coaches in express trains running at high speed and provided with restaurant cars. The running on the Ouest-Etat is splendid, and in places reminds one of the London and North Western Railway. I expect to be returning to 'a base in France' next Tuesday. I cannot say enough for the comfort of the London and South Western Railway steamer *Hantonia*. I hope she will always escape the German submarines. I have seen numbers of the 'Highland Railway' type on the Ouest-Etat almost invariably on goods trains or troop trains."

Railwaymen and Recruiting.

At the end of February the War Office announced that the Railway Executive Committee "are working out a scheme in conjunction with the War Office by which increased opportunities to enlist into the Army will be afforded to men employed by the railways. The scheme will be framed in such a way as not to impair the working of the railways to the best interests of the Government and the trade of the country. Until the scheme can be put into operation railwaymen will only be recruited under the regulations which existed previously."

"Rail Power."

Writing in the March *British Review*, Mr. Vernon Sommerfeld deals with "rail-power," as a factor in strategy, or as he defines it, as a "specialised form of military strength." In fact, he argues that, from the military point of view, railways require to be considered in the same way as is the Navy, their value, comprehensiveness, strategical value, etc., being computed in similar terms; hence he considers that the term "rail-power" is as much justified as is that of "sea-power." Attention is given to the political and war aspects of the Baghdad Railway; also to the value of coast railways for the rapid transportation of troops in the event of an attack upon places not far away by sea, but seriously distant by rail, owing to their being served mainly by radiating branch lines.

The Easter Holidays.

It is a moot question with many people as to whether they will have proper holidays at all this year, or until the war is over. At the same time there is undoubted need in the case of most of us for a "change" of some kind, for which reason there will, no doubt, be a considerable amount of "week-ending," as the spring advances, and especially as long as the railway companies continue to issue week-end tickets, in default of various cheap facilities necessarily withdrawn for the time being. There will be, however, a natural disinclination, in many instances, to go far afield, or to incur more than moderate expenses in railway fares; and for this reason the beautiful country served by the Metropolitan and Great Central Joint line through the heart of Buckinghamshire and the Vale of Aylesbury may be commended, either for a week-end visit extending over the Easter holidays or at other periods, or for a tour on one or more of the few days when all who can do so will be taking a brief respite from business.

By the time Easter is with us spring should be brightening the days and bringing new life into the countryside, and every station on the Metropolitan and the Joint line beyond Harrow is a good centre for exploring historic and beautiful country, with old-world villages, and picturesque hills and valleys, presenting a diversity which appeals to the lover of Nature in a way which is only equalled by districts having more or less similar characteristics. Even with no cheaper facilities than the ordinary fares and special week-end rates the medium distances involved entail that travelling expenses shall not be more than a few shillings, and should it be found possible to reinstate some of the cheap facilities for the holidays, prospective travellers will be still more favourably served, besides which, at most of the places served by this line there is good accommodation for visitors. In addition, some of the nearer stations, Wembley Park, Harrow, and those on the Uxbridge branch, are also good centres for inexpensive tours of the same kind.

Mr. Clement E. Stretton.

We regret to record the death of Mr. Clement E. Stretton, at his residence in Leicester. Son of a former mayor of Leicester, he was educated at Rugby School and articled as an engineer in 1866, commencing to practise as a consulting engineer in Leicester in 1878. He was the author of several books dealing with railways and locomotives, while as a railway historian he rendered splendid service, a wealth of useful material being collected in numerous pamphlets, papers, and articles written by him. He also had much to do with the safety-appliances movement on British railways, and was responsible for collections of railway relics in several museums, and also for the English exhibits at Chicago in 1893

Signalling by Track Circuit.

At a meeting of the Institution of Railway Signal Engineers, Mr. A. F. Bound, Great Central Railway, read a paper which, reduced to essentials, advocated a complete revision of signalling methods, based mainly upon the universal use of track circuits. Indeed, when analysed, his scheme is not really so revolutionary as it appears, for it amounts virtually to developing track circuit, in conjunction with three-position signalling, in accordance with methods which have already obtained a degree of acceptance, and to their logical outcome. One cannot, in fact, criticise the scheme adversely except by quibbling as to its application in particular circumstances, each of which must, of course, be treated on its merits, and by arguing that the author pins his faith too strongly to track circuit, though it is to be presumed that

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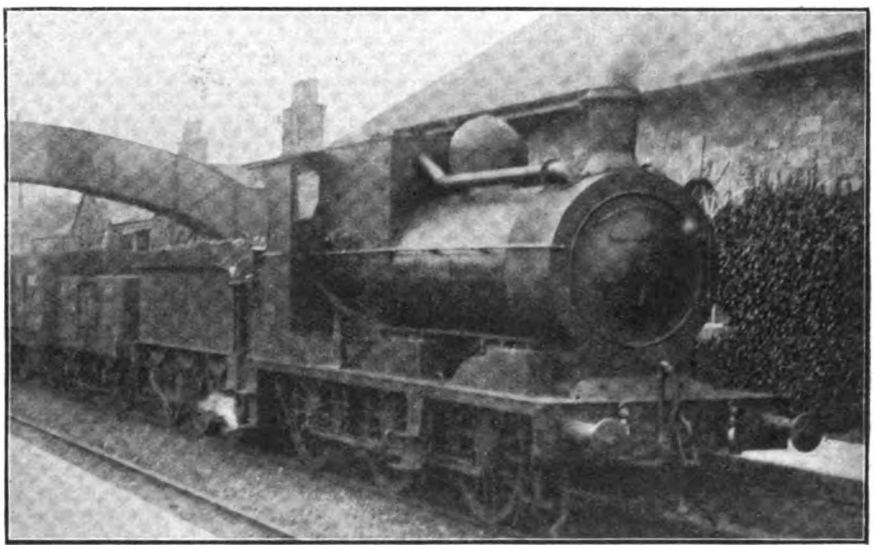
track circuit is already installed because it can be trusted. He suggests that by using track circuits generally, certain signal cabins can be dispensed with, the usual bell code system and instruments become unnecessary, other signalling possibilities are opened up, and, when developed to its logical outcome, it should be possible to add considerably to the capacity of a line of railway by bringing trains closer together without introducing an element of danger. The opening of the discussion showed a tendency to disagree with Mr. Bound, as was, perhaps, to be expected, the general idea being that it is better to develop track circuit as an aid to present methods, at any rate until its trustworthiness is proved beyond question. At a following meeting the discussion will be continued, and no doubt some interesting points will then be raised.

form of the well-known date indicators and the like, but has the rollers working vertically and so arranged that single columns of a time-table are shown through a vertical slot, against the names of stations, the whole train service being brought into view by operating the rollers as required, though only one train is shown at a time. The suggestion is made that these indicators should be installed in the corridors of principal inter-town express trains, the train services being those of the suburban trains of the towns concerned. This would enable travellers to ascertain conveniently connecting services, either from the terminus, or from important junction and inter-change stations, such as Willesden Junction. The idea can also be adapted for main line services, and it can be utilised either by employing rolls prepared from



Photo] [*J. Macartney Robbins.*

MIDLAND GREAT WESTERN RAILWAY.

No. 99, *Cambria* (fitted with Cusack superheater) on goods train at Killucan.

The Cusack Superheater.

MR. J. MACARTNEY ROBBINS sends a photograph of Midland Great Western goods locomotive No. 99 *Cambria* on a goods train at Killucan. This engine is fitted with Mr. Cusack's superheater. Leading dimensions of this engine are: Cylinders, 18 in. by 24 in.; coupled wheels, 4 ft. 9 in.; steam pressure, 170 lbs.; heating surface: firebox, 130 ft., tubes 1,213 sq. ft., superheater 300 sq. ft.; grate area, 20 sq. ft. This apparatus, which is of a peculiar firebox type, is under trial. Meanwhile, nine engines of the "Faugh-a-Ballagh" class are under construction, and the last is to be fitted with the Robinson superheater.

A Novel Time-Table Indicator.

MR. A. DAVIDSON, of Hazeldene, 37 Lynton Road, Springfield Park, Acton, sends particulars of an ingenious time-table indicator. It is in the

the public time-tables, or specially compiled to suit particular requirements. The idea is certainly a good one, especially as it gets over, to a large extent, the confusing element involved by the usual time-tables as viewed by many travellers, seeing that only one train is shown at a time. It is also adaptable for office use, to show principal train services, and in other ways. Mr. Davidson will be pleased to supply further particulars.

G. B. & K. Joint Line Locomotives.

A SCOTTISH reader raised an interesting query, and his letter may be quoted as follows: "I saw in the Central station, Glasgow, the other day, the most queer looking locomotive. It was painted brown and lined yellow. I was unable to photograph it, but have made a sketch of it which I enclose. (The sketch shows a 0-4-4 bunker tank engine, of an old type) I found

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on enquiry that it belongs to the Glasgow, Barrhead and Kilmarnock Joint Railway, and runs on the Beith Branch. It was built in 1875 by an outside firm, and rebuilt at St. Rollox in 1899. It is 0–4–4 type but has no side tanks. I believe it was originally built for the Argentine, but never delivered there."

On taking up this matter with the Caledonian Railway, the following information, which is thought to be of general interest, has been furnished :—

"The engine, which is the only one of its class, works exclusively on the Beith Branch of the Glasgow, Barrhead and Kilmarnock Joint Line. The reason for it being at the Central station, Glasgow, was that it had been recently at our St. Rollox Works for periodical overhaul, and was engaged in shunting work at the Central station for temporary trial purposes. The technical particulars are as follows :—

"5 ft. 6 in. — 17½ in. bogie tank engine. Coupled L. & D., built by Dubs and Co., 1875. Maker's No. 892.

"It was re-built at our Locomotive Works at St. Rollox in 1899. I cannot find that it was originally built for the Argentine, and no photograph of the engine is available. This is the only engine belonging to the Joint Lines working on the Glasgow, Barrhead and Kilmarnock Line, but the Joint Lines have two tank engines employed in shunting work at Greenlaw Goods station, Paisley."

London Traffic Statistics.

From the seventh annual report of the London Traffic Branch of the Board of Trade, viz., for the year 1914, we take the following table, compiled from information obtained from the London County Council, the omnibus companies, and other sources, showing approximately the number of passengers carried in the last ten years by local railways, tramways, and omnibuses :—

Year.	No of passengers carried by— Railway (local companies).	Tramway (approximate).	Omnibus.	Total (approximate).	Estimated population of Greater London.	No. of journeys per head.
1903 ..	290,722,680	394,356,531	287,386,471	972,465,682	6,710,272	144·9
1904 ..	298,638,750	431,813,839	288,965,214	1,019,417,803	6,775,645	150·5
1905 ..	305,052,495	477,944,684	290,665,051	1,073,662,230	6,841,651	157·0
1906 ..	329,521,648	508,700,269	291,563,048	1,129,784,965	6,908,298	163·5
1907 ..	356,233,666	589,745,792	330,000,000*	1,275,979,458	6,975,593	182·9
1908 ..	399,666,339	636,009,090	340,000,000*	1,375,675,429	7,043,540	195·3
1909 ..	410,744,610	687,138,908	311,000,000*	1,408,883,518	7,112,145	198·1
1910 ..	425,271,861	763,797,856	377,207,555	1,566,277,272	7,181,415	218·1
1911 ..	436,498,785	821,819,741	400,628,487	1,658,947,013	7,251,358	228·8
1912 ..	436,492,548	797,487,581	551,622,398	1,785,602,527	7,321,978	243·9
1913 ..	462,019,537†	811,397,317	733,931,201	2,007,348,955	7,393,280	271·5

* Number of passengers estimated on the basis of receipts ; the figures are believed to be underestimated.

The figures of estimated population of Greater London have been recomputed on the basis of the revised census statistics.

† Figures compiled on basis of Railway Companies (Accounts and Returns) Act, 1911, and not strictly comparable with those for previous years.

The total length of railways open for passenger traffic in Greater London at the end of 1913 was 669·2 miles. The number of railway stations, exclusive of halts, was 626. In the following table a comparison is made of the mileage and the number of stations for the years 1903, 1907, 1912, and 1913, with the addition of the proportions of mileage and stations to population and area :—

	In Greater London. 1903.	1907.	1912.	1913.
Length in route miles	607·3	667·4	668·8	669·2
Length per square mile	·88	·96	·97	·97
Population per route mile ..	11,049	10,452	10,842	10,836
No. of stations ..	538	611	623	626
No. of stations per square mile ..	·78	·88	·90	·90
No. of inhabitants per station ..	12,473	11,417	11,639	11,584

Crossings on Track Circuited Sections.

On November 28th a collision occurred between a passenger train and a light engine, at Niddrie North Signal-box, North British Railway. The signalman intended to place the light engine on the goods loop, whereas the driver assumed that, as usual, he would be at once crossed from the down to the up main line through the cross-over just beyond the facing points, and then go away on the up suburban line. He therefore stopped his engine on the crossing, his tender consequently fouling the down main line. Lieut.-Col. E. Druitt, therefore, attributes the collision to the unfortunate action of Driver Mace in bringing his engine to a stand on the crossing, and remaining in that position for 8 min. without sending his fireman back to the signal-box to carry out Rule 55. There was no reason for his assuming a certain course of

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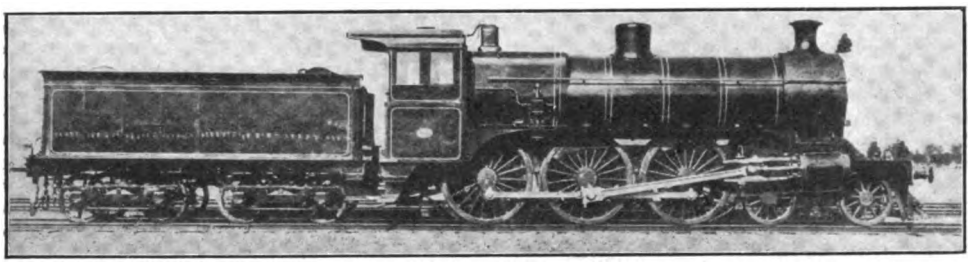
action, as he did, as the home signal for the goods was lowered for him, whereas if he was not to go into the loop there was no necessity for the signalman to shift the facing points, but he would have let him stop on the down main line before setting the main line cross-over road for him to go away on the up line.

The Inspector points out that track circuit was installed ahead of the clearance bar in the down main line up to the starting signal, and that there was a clearance bar in the crossing behind the trailing points in the goods loop, but there was a space of 160 ft. between the end of this clearance bar and the facing point lock-bar in the down main line, so there was plenty of room for the engine to stand between the two, and foul of the down main line. As he remarks, "it was no doubt never anticipated that a driver would stand his engine in such a position on a crossing, foul of the down line," and suggests that "the Company might consider the advisability of providing an additional clearance bar to ensure the main and suburban line down home signals being kept at danger should an engine stand on the crossing foul of the down main line as in this case."

4-6-0 LOCOMOTIVES: VICTORIAN STATE RAILWAYS.



An Australian reader sends a photograph, reproduced above, of one of the standard express locomotives employed on the Victorian State Railways. These were designed by Mr. W. M. Shannon, M.I.M.E. Leading dimensions are: Cylinders, 21 in. by 26 in.; height of boiler centre from rail, 8 ft. 6 in.; heating surface: tubes, 2,090 sq. ft., firebox, 172 sq. ft.; total 2,262 sq. ft.; grate area, 33 sq. ft.; working pressure, 220 lb.; coupled wheels, 6 ft. 1 in. diam.; bogie wheels, 3 ft. 7 in. diam.; rigid wheelbase, 13 ft. 4 in.; total wheelbase, 26 ft. 3 in.; capacity of tank, 6,400 galls.; capacity of bunker, 7 tons; weight of engine and tender, 115 tons. Special fittings include Belpaire boiler, Westinghouse brake, Galloway Hill firebox, and Wakefield mechanical lubricator. We are indebted to Mr. J. H. Cherry for particulars of a new class of 4-6-0 superheated (Schmidt design) mixed traffic engine recently introduced on the same railways. The engine is fitted with the Westinghouse quick-acting automatic brake, also a Bosch mechanical lubricator, and piston valves. The bogie wheels have sufficient side play to pass round curves of 5 chains. The cylinders, inclined at 1 in 15, are 19 in. by 26 in., and the piston valves are 10 in. by 5 in. travel. The boiler, with its centre 7 ft. 6 in. from the rail level, contains 107 tubes 2 in. diam., and 18 tubes 5 in. diam. The outer firebox is 7 ft. 2 in. long and 3 ft. 11 in. wide. The heating surface is arranged as follows: Firebox 120 sq. ft.; small flue tubes, 721 sq. ft.; large flue tubes, 316 sq. ft.; superheater, 335 sq. ft.; total, 1,492 sq. ft. The grate area is 22½ sq. ft., and the working pressure 165 lbs. The bogie wheels are 3 ft. 7 in. diam. spread over 6 ft. 3 in.; and the coupled wheels 5 ft. 1¾ in.; the coupled wheel-base is 5 ft. 6 in. from leading to driving, 7 ft. 6 in. from driving to trailing. The total wheel-base is 26 ft. 9 in. The weight on the coupled wheels is 40 tons (approximate). The double bogie tender carries 5 tons of coal and 4,400 gallons of water. Engine and tender in working order weigh 94 tons.

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WORK has been commenced on the new dining room adjoining the Great Hall at Euston, London and North Western Railway. The kitchen accommodation has already been completed, and the new Refreshment Room on No. 9 Platform is nearing completion. The east end of the new booking hall is in use. Additional offices over the east and west wings are finished and occupied. Since the outbreak of war, all works of construction have been delayed on the new Euston–Watford lines. The transport of materials has been interfered with, and the supply of labour has not always been adequate, but on the portion of this new line still to be completed between Chalk Farm and Willesden considerable progress has been made. Between Queen's Park and Willesden the works are approaching completion, and this section will, it is expected, be brought into use very shortly. At Chalk Farm the old three-span bridge which carried Regent's Park Road over the railway has been removed, and the new single-span bridge will soon be finished. Between this point and Primrose Hill the railway cutting has been widened and the bridges and tunnels for the junctions between the new electric lines and the existing lines to Euston and Broad Street are being constructed. Preparations are now being made to begin driving the cast-iron tunnels under Primrose Hill. The new electric power station and repair shed at Stonebridge Park are well advanced, and the six electric sub-station buildings are now being roofed. Considerable progress has been made with the carriage shed at Watford and the shed at Willesden is in hand. The electrical equipment of the West London Railway between Willesden and Earl's Court has been completed. The track work for the remainder of the lines to be electrified is in hand.

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HALTS have been constructed and opened for traffic on the London and North Western Railway at Carpenders Park (between Pinner and Bushey) and at Billinge Green (between Northwich and Middlewich). The new sleeper creosoting depôt at Northampton has been completed and brought into use, and the old depôt at Mitre Bridge, Willesden, is now closed. The new railway at Coventry was completed in August. An additional line is being laid on a portion of the Coventry and Kenilworth branch, which is at present a single line. The up loop at Foleshill, on the Coventry and Nuneaton line, is complete and in use, and the permanent way is being laid for the down loop. Additional goods accommodation, consisting of an extension of the goods shed and yard, is being provided at Mesty Croft, near Wednesbury. Reconstruction of the passenger station at Nuneaton is being proceeded with, but the progress of this work was considerably delayed. Additional accommodation for goods traffic has been completed at Diggle and Warrington (Bank Quay) stations, and similar accommodation is now in course of construction at Marsden. The extension of the wagon works at Earlstown, and the reinforced concrete gantry and bunkers for the coaling of locomotives at Edge Hill, have been brought into use. Widening works between Abergele and Llandulas, on the Chester and Holyhead Railway, are not yet complete, having been delayed by bad weather and the difficulty of obtaining men, but the contract works are nearly finished, and progress is being made with the laying of the permanent way. At Holyhead additional sheds are being built for dealing with the Irish cattle traffic. A new goods station is in course of construction at Blackwood, on the Sirhowy line. Additional goods accommodation is being provided at Ellesmere Port.

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IN connection with a re-arrangement of traffic divisions on the Great Western Railway, an additional division has been formed, with headquarters at Westbury. It embraces the section of line Newbury, Enborne Junction (exclusive) to Athelney; the Marlborough, Salisbury, Martock, Bridport, and Abbotsbury branches; the line from Castle Cary to Weymouth, and the Portland and Easton lines. The line from Didcot, Foxhall Junction (exclusive) to Highworth Junction, and the Faringdon branch have been transferred from the London to the Bristol division. The line from Durston Junction (exclusive) to Uphill Junction has been transferred from the Exeter to the Bristol division. The line from Brent (exclusive) to Ashburton Junction, and the Ashburton and Totnes Quay branches have been transferred from the Plymouth to the Exeter division. The line from Kidlington to Aynho Junction, and Aynho Junction to Aynho Park has been transferred from the Birmingham to the London division.

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These changes were rendered necessary owing, among other reasons, to the increasing use of the Berks and Hants and Westbury route by through expresses between London and the West of England; also to the development of the use of Salisbury Plain for military purposes.

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THE FURNESS RAILWAY RIFLE CLUB, established at the old joiners' shop in the wagon works at Barrow, was opened on Monday, March 1st by Mr. Alfred Aslett, J.P., Secretary and General Manager. Mr. D. L. Rutherford, Chief Engineer, presided. It had been intended to open this range some months ago, but the site had to be reconsidered, and instead of having the range in the permanent way stores it had been decided to have it in the old joiners' shop in the wagon works, which was in many ways much more convenient, the length being 117 ft., and 16 ft. wide. Mr. Aslett mentioned that several railway companies had formed rifle clubs, which had led to numerous interesting inter-competitions between the railway companies' teams. On such occasions challenge cups and medals have been competed for, in which competitions, he hoped, the Furness Railway would compete in the future. He was reminded of his past association with the celebrated Robin Hood Volunteer Regiment of Nottingham, whose uniform was after that worn by the historical Robin Hood—Lincoln green. He had no doubt that the Nottingham Robin Hoods at the present time were wearing khaki, but the Lincoln green would appear again when the great and deplorable war on which we were engaged was brought to a close and peace was declared—the sooner the better. Mr. Aslett well remembered that in the first year he had to go through his class firing at the shooting range of the Nottingham volunteers over 40 years ago, much to his discomforture he did not hit the target in the first fifteen shots at 100, 200, and 300 yards' range. He was not, however, one of those who could sit down quietly without making a strenuous effort to overcome this great failure on his first appearance at a shooting range. Two years afterwards, Mr. Aslett said, when shooting for the challenge cup of the Robin Hood Volunteers, he made four consecutive bulls eyes at 500 yards' range. A little over two years ago, when reopening the Ulverston Miniature Rifle Club, he expressed a hope that the time would not come when it would be necessary for the Territorials or National Reserves—of which he was proud to be a member—to be called out to serve their country, but, alas, Germany had decided otherwise. Whatever position he might occupy at the present time as Secretary and General Manager of the Furness Railway—an important post under Government control—he would always strive his utmost to do his duty, and so much so that there had not been a single Sunday, except on Intercession Sunday, that he had not been continually engaged on railway work since the war commenced. In saying this he felt sure that every officer and member of the staff of the Furness Railway Company was prepared, whether on Sundays or week days to do his utmost to serve his King and country during the present crisis.

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WE have received from Mr. F. Seaton-Snowdon, 22, Henrietta Street, Covent Garden, London, W.C., particulars of his Weights and Measures "Computor." This is designed to save abstruse labour and by ensuring mechanical accuracy acts as a labour saving device for those engaged in commercial transactions with foreign countries, as it enables them by the mere turning of a handle, to instantly and accurately convert the value of goods offered in the currency and measures of one country into the correlative equivalent of the coinage and measures of another country. It not only automatically transposes the values expressed in the coinage, weights and measures of the countries named into those of others, but also gives at one and the same reading the same information in respect to the coinage, weights and measures of Japan, America and Canada, making for the two last named countries the necessary corrections in regard to the American gallon and the "Short" ton. The instrument closely resembles the familiar date indicator and is equally simple in its manipulation, it being so arranged that by the mere movement of one of two handles the cost in pounds, shillings and pence of an English lb., gallon or foot can be instantly and accurately read off in the equivalent units of any foreign measure of weight, capacity or length, together with its value in the coinage of its country.

* * *

WAR conditions have brought many strange vessels to Newport, and the value of the new lock entrance recently brought into use by the Alexandra (Newport and South Wales) Docks and Railway, has been fully demonstrated. The Hamburg-American liner, *Belgia*, was the first German ship to be captured. She was brought into Newport, said the Chairman of the Alexandra Company, Sir Henry Mather Jackson, "largely through the exertions of our own officials immediately after the declaration of war, and is still in the dock, her cargo having been discharged and a considerable portion stored in the Company's warehouses. This vessel, which is 501 ft. long, gross tonnage 8,132, was the largest that had up to then entered the dock, but since then much larger vessels have also entered. On August 20th the Cunard liner *Ascania*, gross tonnage 9,111, sailed from Newport with about 500 passengers, who were conveyed through to the quay alongside the ship in trains provided by the Great Western Company. The Royal Mail Company have already sent in some fine vessels, two or three of which have also taken passengers, and quite recently we had a P. and O. vessel. The largest ship we have dealt with is one belonging to the Union Castle Steamship Company, the *Kenilworth Castle*, which has a length of 560 ft., and a beam of 65 ft., gross tonnage 12,975. Many

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other ships, no doubt, would have used the port had more warehouse accommodation been available; but there has been great pressure on the warehouse space all over the country for the storage of foodstuffs, etc."

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MR. W. VILLAGE, chief commercial clerk, General Superintendent's department, Midland Railway, has been appointed to the position of General Passenger Agent rendered vacant by the death of Mr. H. T. Jackson. Mr. Village entered the service in 1874 as a junior clerk in the goods department at Doncaster. Shortly afterwards he was transferred to the department of the superintendent of the line, and after two or three years of station experience at several places he was removed to the head office of that department at Derby, where he has filled various positions, including chief indoor inspector and chief clerk to the passenger agent. The following appointments were also made, in connection with the chief goods manager's department: Mr. J. Roughton, Leicester District Goods Manager, to the dual position of Birmingham District Goods Manager and Goods Agent for Birmingham, in the place of Mr. J. Gold, retired; Mr. A. G. Aitken, District Traffic Superintendent for Swansea Vale, to succeed Mr. Roughton as Leicester District Goods Manager; Mr. T. E. Argile, assistant to Mr. H. F. Loney, Outdoor Assistant Goods Manager, Northern division, to succeed Mr. Aitken as Swansea Vale District superintendent.

Mr. Roughton entered the service in 1875 as booking clerk at Oakham, and a little later was removed to Chapel-en-le-Frith. In 1876 he was transferred to Ashby-de-la-Zouch, and in 1883 to Stanton Gate. In 1885 he was promoted to Woodville as goods clerk, and in 1886 was made relief clerk under the superintendent of the line. In 1891 he was appointed stationmaster at Kirkstall, and was promoted to the post of goods agent at Lancaster in 1893. He was appointed goods agent at Nottingham in January, 1903, and goods agent at Sheffield in September, 1906. In August, 1909, he succeeded Mr. D. R. Mason (the present London district goods manager) as district goods manager at Leicester.

Mr. Aitken entered the service in September, 1870, as a junior clerk at Miller's Dale, and joined the outdoor department at Derby in 1874. He was made outdoor inspector on the Erewash and Leen Valley districts, September, 1892; appointed chief outdoor assistant to the Derby district goods manager's department, January, 1903; and secured further promotion as general agent for Liverpool and assistant to the Liverpool and Manchester district goods manager, January, 1909. He succeeded Mr. H. F. Loney as district traffic superintendent for Swansea Vale on January 1st, 1914.

Mr. Argile entered the service in October, 1896, as a junior clerk in the canvasser's office, chief goods manager's department, Derby; went in a similar capacity to the general manager's department in 1898; was transferred to the Leicester goods department in 1900; returned to Derby in 1902 as private clerk to Mr. Adie, then chief goods manager; and since 1907 has been an inspector connected with both the Derby district goods manager's and chief goods manager's departments.

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WORK connected with the electrification of the London and South Western Railway Company's suburban lines has, notwithstanding various difficulties, made steady progress during the past year. The main power house at Wimbledon and the sub-power stations at other places are practically completed, and the machinery for working them is being erected. Several of the new electric trains have been constructed and the remainder are being proceeded with. Good progress has also been made with the placing of conductor rails, the bonding of track rails and the laying of high-tension cables on the first section of the railway to be electrified, namely, the lines from Waterloo to Kingston *viâ* Twickenham and *viâ* Malden. At Waterloo station work has been much hampered by the dispute in the building trade and, since the commencement of the war, by the dearth of labour and shortage of material. But in spite of these drawbacks three platforms have been reconstructed, the covered cab yard adjoining the Waterloo Road has been completed, and a portion of the northern approach from the York Road brought into use. A further block of new offices and an additional section of platform roofing are in course of erection. Other works in hand include a widening of the line on the down side at Nine Elms and a new down line and fly-over bridge between Surbiton and Hampton Court. Both these works are well advanced.

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AT the annual meeting of the Furness Railway Company, Lord Muncaster, who presided, rendered a tribute to the capabilities of Mr. Alfred Aslett. In reference to passenger and steamboat traffic, he attributed increases largely owing to the energetic and capable administration of our Secretary and General Manager. These increases were, however, partly counterbalanced by decreased net revenue, this being due, as the Chairman explained, owing to exceptional conditions. The iron and steel industry has been in a depressed condition, but more furnaces have been put into blast, and more ore is wanted. "We are under Government control and we are doing the best with the means we have. The Furness Railway are very fortunate in having such a General Manager and Secretary, whose work has been very great." In reply, Sir Thomas Crosby said he cordially agreed with the Chairman's remarks in regard to their General Manager and Secretary. He wrote to him an amusing sentence a short time ago, saying he was the ablest person he ever knew to "help lame dogs over stiles," and the "lame dog" in this case was the Furness Railway. He was very grateful for the services he had rendered to the Company, and they could not have a more able defender of their railway than Mr. Aslett.

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AN illustration is reproduced on this page showing one of the platforms, Baker Street station, and the stairway leading to the escalators connecting with the "Bakerloo" station below. These stairways are the first to be used on the "Met." and have a vertical height of a little over 30 feet long, and measure on the slope 70 feet. The stairs run at a speed of 90 feet per minute and have a capacity of 12,000 passengers an hour. Two minutes are saved by the use of the stairways. A train is standing in the bay road and the photograph also shows platforms Nos. 2, 3 and 4. There are two sets of machinery for working the "Up" and the "Down" stairways, one set on either side, each containing two 600 volt, 42 amp., 30 H.P. motors, running

THE Great Western Railway continues its practice of painting over the brass dome and safety-valve covers of its older locomotives as these pass through the shops for extensive repairs. It is now quite the exception to see one of the older passenger or goods engines in that livery of burnished brass which was once such a characteristic of the Company. However, the Great Western is not the only railway to adopt this practice. The copper-capped chimney still reigns supreme on this line, and the bright brass safety-valve casing is still retained on all the locomotives fitted with the standard coned boiler.

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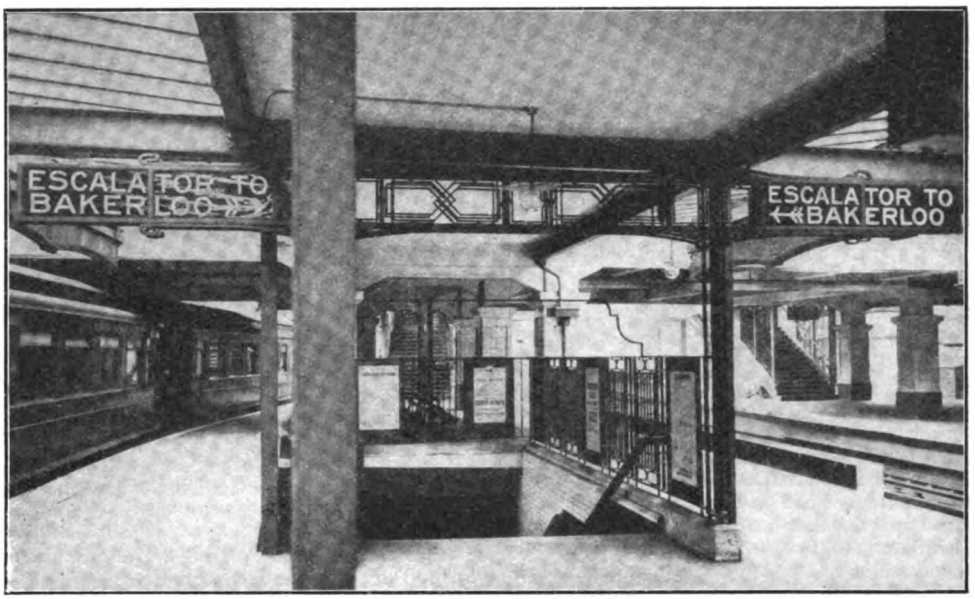
IN conjunction with the comprehensive



STAIRWAY TO ESCALATORS CONNECTING THE METROPOLITAN AND THE LONDON ELECTRIC STATIONS AT BAKER STREET.

at 650 revolutions per minute, one motor working and one standing spare on either side in case of breakdown.

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THE Metropolitan District Railway Bill to be promoted in the ensuing Parliamentary Session, provides for widenings in the immediate vicinity of Hammersmith station. Powers are sought to construct a single line so as to relieve the traffic going westward, and it is also proposed to make considerable alterations in the existing platform arrangements, so as to admit of the Piccadilly Railway using the existing tunnel in conjunction with the District Railway. The new railway will pass under Hammersmith Broadway, and will be at a depth of 16 ft. 9 in. below the surface of the roadway. The limits of deviation include a portion of the Council's subway on the east side of the existing railway.

scheme of improvements now in progress by the Great Western Railway in South Wales, the construction of a new line from Llandilo Junction to Court Sart, Briton Ferry, thereby considerably shortening the Fishguard-London route, is virtually completed. This new line has already been opened informally for goods traffic, and will be ready for passenger service very shortly. By this new route both Swansea and Neath will be entirely cut off the main Fishguard line. It will, however, afford a much better outlet for the coal traffic from the Amman Valley and other coal areas north of Llanelly.

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A FOUNDATION at the London School of Economics and Political Science has been endowed by Lord Rosebery, whereby two prizes, one of £25 and one of £10 will be awarded annually for the best monographs on a question dealing with the history, theory, or organisation

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of inland transport. The monographs may represent either a piece of original research on a subject which has previously been submitted for approval, or be written on a set subject. Such set subject shall be announced in the year preceding that in which the monographs must be presented. For 1916 the subject is "Workmen's Trains." Candidates must be present or past students of the London School of Economics and Political Science. Two or more students may combine and present a joint monograph. Monographs must reach the Director of the School not later than September 30th, 1916. The option will lie with the School of publishing the monograph to which is awarded the first prize.

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As Railway Magazine readers are aware, under the Railway and Canal Traffic Act, 1913, power was given the English railways to raise their rates to meet the increased expenditure due to higher wages and improved labour conditions. Though this Act did not extend to Ireland, the Irish companies decided to raise their rates in like manner, as the same conditions as regards increased cost of working equally applied. The Great Southern and Western Railway, however, under the Amalgamation Act, was debarred from raising rates without the consent of the Railway and Canal Commissioners. An application for permission was accordingly made, but was refused, so that the Great Southern and Western Railway is the only large company in Ireland unable to raise rates to meet increased wages and expenditure.

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Since the working agreement between the Great Western and the London and South Western Railways was made, engines of the latter company have occasionally worked trains over the Great Western line between Salisbury and Bristol. This practice was usually confined to the conclusion of the August manœuvres. Since the outbreak of war this practice has been considerably extended, particularly in January and February, and during the first fortnight of the latter month the passage of South Western locomotives over this section of the Great Western line was a daily occurrence in connection with the working of troop trains. The engines selected for this duty belonged to the various 4–4–0 classes designed by the late Mr. D. Drummond.

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A publication which has just been issued by the Great Northern Railway Company should prove extremely useful to agriculturists, fanciers, horse and cattle dealers, sportsmen, etc. It takes the form of a handy booklet, and gives particulars of the principal dog and poultry shows, horse and cattle fairs, agricultural shows, and racing fixtures to be held during 1915, in addition to a large amount of information as to rates, fares, etc. Copies may be obtained gratis on application to any Great Northern Station or Office, or from the Superintendent of the Line, King's Cross Station, London, N.

The Metropolitan Railway are now paying a war bonus to their employés. An addition has been made to the current pay at the rate of 3s. per week to servants over 18 years of age in receipt of less than £80 per annum; and 2s. per week to all whose standard earnings are over that amount. The arrangement is intended to remain in force during the period covered by the Railway Agreement with the Government, but is subject to review at the end of three months.

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It is hoped that by the end of the present year the new electric services between Broad Street and Kew and Richmond over the Hampstead Junction line will be in working order. The extension of the Bakerloo tube to Queen's Park was opened on February 11th, and until such time as the through route to Watford can be opened arrangements are being made to enable a certain number of tube trains, instead of terminating at Queen's Park, to run through to Willesden Junction, where frequent connection with main line and local London and North Western trains may be made.

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The annual general meeting of the Institution of Locomotive Engineers was held on Friday, February 12th. Mr. A. J. Hill, the President, Locomotive Superintendent, Great Eastern Railway, presided. Reports were presented by the secretary, Mr. G. F. Burtt (who also dealt with the balance-sheet, in his capacity of treasurer), and by the Chairman, Mr. C. A. Suffield. The President also presented premiums for the three best papers read during 1914, as follows:—

(1) Mr. E. L. Ahrons—"The Internal Disturbing Forces in and Balancing of Locomotives (with special reference to Three and Four-cylinder Engines)."

(2) Mr. A. Kingsley Ward—"The Application of the Diesel Engine to Locomotives."

(3) Mr. A. Woolford—"Pumps and Injectors for Feeding Locomotive Boilers."

Mr. Hill then gave an interesting Presidential address on "The Education of an Engineer."

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Recognition by the Board of Trade and the Lords Commissioners of the Admiralty of the way Capt. Lawrence, of the Great Eastern Railway steamship s.s. *Colchester* manœuvred his vessel so that he escaped capture by a German submarine was conveyed to Capt. Lawrence on February 18th, when Lord Claud Hamilton, M.P., on behalf of the Board of the Great Eastern Railway, presented him with a gold watch bearing the inscription:—"Presented to Capt. Lawrence by the Chairman and Directors of the Great Eastern Railway Company as a mark of their appreciation of his courage and skilful seamanship on December 11, 1914."

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An order for five six-wheeled coupled goods engines of modern type, two being for delivery this year and three next year, have been ordered by the Cambrian Railways. A sum of £1,200

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has been allotted for an additional passing place between Llanbrynmair and Cemmes Road. During the winter a service of steam-heated trains has been introduced on the coast section. Two third-class carriages are in course of conversion for use as observation cars on the coast line during the summer. The large timber bridge at Traethmawr, near Portmadoc, has in part been substituted by an embankment, and the remainder entirely rebuilt; the work of strengthening the bridge over the Dovey at Dovey Junction has been completed.

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THE Liverpool Overhead Railway carried during the year 1914 on railway and tramway, exclusive of season ticket-holders, a total of 13,361,944 passengers, being an increase of 178,623 on 1913, and nearly 1,200,000 over 1912, and being the greatest number since the railway was opened for traffic. This represents an increase of 5 per cent. in the first class and 1 per cent. in third class, but a decrease in the "workmen" class of 3 per cent. The general increase is partly due to the presence in the spring of the *Aquitania* in the Gladstone Dock, which proved a great attraction, while the encampment of troops at Seaforth, Waterloo, and Crosby materially helped tramway traffic in the early autumn.

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FIRST-CLASS traffic on the London, Brighton and South Coast Railway is showing considerable increases at such places as Brighton, Eastbourne, Worthing, Hastings, and elsewhere, presumably on account of the fact that many of those travellers who usually migrate to France and Switzerland for the winter months have this year taken their holidays on our south coast. The electrical services running in the districts between Victoria and London Bridge, Victoria and Crystal Palace, and London Bridge and Crystal Palace in particular, have shown marked expansion.

* * *

THE new stations at Goldhawk Road and Uxbridge Road on the Hammersmith and City line are attracting a considerable amount of new traffic, and the escalators that have been put in at Baker Street to connect the Metropolitan station with that of the "Bakerloo" line have largely increased exchange traffic at that point. The only section of the widening between Finchley Road and Wembley not yet completed is the viaduct at Kilburn. The contractors are pushing on with the work of constructing the new viaduct as quickly as possible; but it is hoped to open the widening throughout in the coming summer.

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THE latest London and North Western engines of the 4-4-0 ("Precursor") type to be altered to superheaters are Nos. 643 *Sirocco* and 659 *Dreadnought*. Both these engines are fitted with piston valves and extended smoke-boxes. No. 1277, a four-cylinder compound mineral engine, has been converted to simple, with larger boiler and cylinders 20½ in. by 24 in. There are now two engines of the "Claughton" class stationed at Camden, and two also at Liverpool, those at the former place being Nos. 1191 *Sir Frank Ree* and 1429 *Colonel Lockwood*, and at the latter Nos. 668 *Rupert Guinness* and 1327 *Alfred Fletcher*. The Camden engines work daily to Crewe: *Colonel Lockwood* the 12.10 p.m. down and 5.5 p.m. up, and *Sir Frank Ree* the 2 p.m. down and 7.32 p.m. up. Only one of the Liverpool engines is at present in regular working, viz., *Rupert Guinness*, which works daily to London, leaving Lime Street at 11 a.m., returning from Euston at 6 p.m. The other engine, *Alfred Fletcher*, will probably shortly take its place on the 8 a.m. to London, returning therefrom with the 2.40 p.m.

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BERWICK-ON-TWEED is to have a new railway station. Plans have been passed by the North British Railway Directors, and the work is shortly to commence. It is understood the cost will be between £30,000 and £40,000. A feature of the scheme is an island platform between the up line and the down line. This will be 800 ft. in length, and it will be reached from the booking hall (which will be about where the present booking office is) by means of a bridge; and there will also be an hydraulic luggage lift. The up line will be about where the present down line is, thus straightening out the present curve from the Royal Border Bridge. This scheme includes thoroughly up-to-date waiting-rooms and offices. The first portion of the scheme which will be executed is the new bridge carrying the great North Road over the railway. This will be a little to the south of the present bridge, which is the property of the Railway Company. Borings for the new bridge have already been made, and the work is to proceed forthwith. A history of Berwick station to which many readers may like to refer appeared in the RAILWAY MAGAZINE, June, 1909.

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A NEW station, to be called North Harrow, situated between Harrow and Pinner stations, on the Metropolitan and Great Central joint line, was opened for traffic on March 22nd. The necessity for this station is due to the rapid development of the Glebe, Roxboro' Close, and other estates adjoining the station, and it may be confidently predicted that with the excellent fast and frequent train service, running direct to and from the City, this station will prove a boon, not only to the residents in the neighbourhood, but also to those visiting the charming country opened up.

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MR. CHARLES MORTIMER, Chairman, Railway Clearing House, has resigned that position on account of ill-health. Mr. Mortimer has represented the Great Western Company upon the Clearing House Committee continuously since 1891, and for the last seven years has occupied the position of Chairman. His resignation was received by his colleagues with great regret, and they placed on record their high appreciation of the able services which he had rendered during

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the time he occupied the chair, and of his unvarying courtesy to them. Mr. Hugh Wyndham Luttrell Harford, who represents the Midland Railway Company, of which he has been a Director since 1906, has been elected Chairman of the Railway Clearing House in succession to Mr. Mortimer.

* * *

MR. CECIL J. ALLEN read an interesting paper on "Anglo-Scottish Train Services," on Tuesday, March 9th, at the Railway Club. He dealt first with the historical development, and after reviewing recent facilities, presented a few suggestions as to possible improvements. On Tuesday, April 13th, Mr. E. J. Miller will give an address, illustrated with lantern views, on "Characteristics of Swiss Railways."

* * *

THE London and South Western Railway give notice that for the time being the Sunday night service from Southampton to Havre or from Havre to Southampton will be discontinued.

THE necessary strengthening of certain underbridges on the Midland system at Bath has been completed, and since the first week in February the heavy 2-8-0 mineral engines of the Somerset and Dorset Joint Railway have been given access to the sheds and repair shops at Bath. Prior to this, they were stationed at Radstock.

* * *

THE Taff Vale and the North Staffordshire Railways have adopted large initials for their goods stock—"T.V." and "N.S." respectively—following the practice of the Great Eastern, Great Western, Great Northern, and Great Central Railways.

* * *

A LONG-FELT want by members of the Great Western Railway salaried staff at Paddington has been met by the Directors generously providing a rifle range. It is situated on the roof of the Paddington Goods offices, within a few minutes' walk of the station and General offices. A rifle club has been formed in connection with the range. Viscount Churchill, G.C.V.O., Chairman of the Company, formally opened the range on January 15th.

* * *

MILK DOCK AT WILLESDEN GREEN, METROPOLITAN RAILWAY.

The dock is situated at the end of the Up through road, near the goods shed, and deals with a very large amount of milk traffic from country stations.

THE Board of Trade have recently confirmed the under-mentioned Order made by the Light Railway Commissioners:—London and North Western Railway (Dyserth and Newmarket Light Railway) Order, 1915, authorising the construction of a Light Railway in the County of Flint, from Dyserth to Newmarket.

* * *

MR. FRANK DUDLEY DOCKER has been elected to the Board of the Metropolitan Railway Company, to fill the vacancy caused by the retirement of the Hon. Francis McLaren, M.P., who has recently accepted a commission in his Majesty's Forces. Mr. Docker is Chairman of the Metropolitan Carriage, Wagon and Finance Company, of Saltley, Birmingham.

* * *

AN additional 60-min. express between Glasgow and Edinburgh, North British Railway, is given by the retiming of the 9.35 p.m. (weekdays and Sundays) express from Queen Street. The 9.5 a.m. express from Waverley on weekdays now leaves at 9.7 a.m., the times at other stations being unaltered.

To the *Red Cross and Ambulance News* Mr. John M. Cooper, a son of the General Manager of the Glasgow and South Western Railway, has contributed an interesting series of articles on the ambulance trains of British railways. These have already been described in the RAILWAY MAGAZINE, and in addition the author deals with other items of interest. Mr. Cooper has since taken up a commission with his old regiment, the 5th Battalion Scottish Rifles, and is now serving with the colours.

* * *

MR. A. K. T. BRANDRETH points out that Mr. Robinson's 2-6-4 tank engines were not quite the first in Great Britain having this wheel arrangement, as it is found in the narrow-gauge tank engines of the Leek and Manifold Light Railway, worked by the North Staffordshire Company.

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THE Great Eastern Railway announce that in addition to tourist, fortnightly, and Thursday, Friday or Saturday to Monday or Tuesday tickets to the East Coast and the Norfolk Broads districts (Aldeburgh, Clacton-on-Sea, Cromer, Dovercourt Bay, Felixstowe, Gorleston-on-Sea, Harwich, Hunstanton, Lowestoft, Mundesley-on-Sea, Sheringham, Southwold, Walton-on-Naze, Yarmouth), which are issued from Liverpool Street and other London and suburban stations, there will be special excursion bookings on Thursday, April 1st, from London (Liverpool Street) and suburban stations to all the principal stations in the Eastern Counties, including Norwich, Cambridge, Wisbech, King's Lynn, Fakenham. The cheap week-end tickets issued from London on Saturday, April 3rd, will be available for return on April 4th, 5th and 6th. Tickets (excursion, ordinary, etc.), can be obtained in advance at Liverpool Street station, at the Great Eastern West End Ticket and Enquiry Office, 12a, Regent Street, and at the Company's various City, West End, and other booking offices. On Thursday, April 1st, in addition to relieving trains a special train will be run from Liverpool Street at 12.5 midnight for Chelmsford, Colchester, Frinton, Walton and Clacton. Certain ordinary trains which have been temporarily suspended will be reinstated for this day. On Good Friday, with certain modifications and additions, the trains will run the same as on Sundays. A special train will be run at 5.5 a.m. from Liverpool Street to Ipswich, calling at the principal intermediate stations. On Saturday, April 3rd, for the accommodation of persons detained at business until late in the evening, special midnight trains will leave Liverpool Street at 12.20 for Norwich *viâ* Cambridge, at 12.30 for Frinton, Walton, Clacton, Ipswich, Yarmouth and Lowestoft *viâ* Colchester, calling at the principal intermediate stations. The 12.5 night supper train from London to Clacton will not run. Restaurant cars will be run from London to Colchester and Clacton on the 12.30 night special and will be vestibuled to the Yarmouth and Lowestoft sections as far as Colchester. The midnight supper train from Liverpool Street to Southend will run as usual. On Easter Monday several main line and branch lines and Southend line trains will be cancelled; the 7.33 a.m. *ex*-Yarmouth and 7.55 a.m. *ex*-Norwich-Thorpe to Liverpool Street will be run on Tuesday, April 6th, instead. Certain ordinary trains which have been temporarily suspended will be reinstated for this day.

* * *

ALTHOUGH Easter will probably be spent quieter than usual, there is no reason why a pleasant and restful time should not be enjoyed on the South Coast, which offers an excellent substitute for the Continental Resorts not now available. An excellent testimony to the recuperative qualities and tonic of the air is the fact that the splendid Indian and other brave troops are now undergoing treatment at Brighton and other South Coast towns. Brighton, Worthing, Seaford, Eastbourne, Bexhill, St. Leonards, Hastings, Littlehampton, Bognor, Southsea, Portsmouth and the Isle of Wight are making special efforts to satisfy their patrons by providing good music and other attractions suited to the circumstances of the present time. Their close proximity to the Metropolis makes these towns particularly convenient for any who feel, for various reasons, that they must be near London.

The Brighton Railway Company has made special arrangements over the holidays for the conveyance of a large number of visitors to the Coast. Full details will be sent on application to the Superintendent of the Line, Brighton Railway, London Bridge, on receipt of a postcard.

Extra trains will be run from London Bridge, Victoria, etc., to the South Coast towns on Wednesday, Thursday, Friday, Saturday and Sunday, March 31st, April 1st, 2nd, 3rd and 4th. The Brighton Company announce that at their West End Offices, 28, Regent Street, Piccadilly, ordinary tickets to all parts of the line, and to the Continent, can be obtained at the same fares as charged at London Bridge and Victoria. Similar tickets at the same fares may also be obtained at the usual Agencies.

* * *

SINCE the Superheater Corporation commenced the construction of the "Robinson" Superheater they have applied it with invariable success and have carried out over a thousand installations. Many test installations have been followed by orders for a considerable number of similar superheaters. The Company point out that this superheater is the invention of a British engineer, Mr. J. G. Robinson, Chief Mechanical Engineer, Great Central Railway; that all the capital of the Corporation is in British hands; and that the directors and staff are and always have been entirely British.

* * *

MR. H. MARRIOTT, Chief Goods Manager, Lancashire and Yorkshire Railway, has been appointed to the Chairmanship of the Irish and English Goods Traffic Conference for the current year.

* * *

MR. G. W. OTTER HUDDART, having received a Commission in H.M. Forces, resigned his seat on the Board of the Festiniog Railway. Mr. John Macaulay, formerly general manager of the Alexandra (Newport and South Wales) Docks and Railway, has been elected to fill the position thus vacated.

* * *

ALTHOUGH the Highland Railway Company was exonerated from all responsibility for the accident at Carr Bridge, when the bridge over Baddengorm Burn was washed away by a cloud-burst and a train derailed with fatal results, the directors, while declining to admit responsibility for the accident, have allotted a sum of £1,000 to be divided among the sufferers and their dependents.

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MR. KENNETH WILLIAM DOUGHTY, of the Accountant's Department, Midland Railway, Derby, has been appointed Accountant of the Great Western and Midland Railway Companies' Severn and Wye Joint Railway in succession to Mr. T. A. H. Smith, who retires on superannuation. Mr. Doughty entered the Midland service in the book-keepers' office, accountant's department, Derby, in November, 1899, was afterwards transferred to the joint accounts staff, and latterly has held the position of head of the insurance office.

* * *

SIR GILBERT CLAUGHTON, Bart., Chairman, London and North Western Railway Company, has been elected Chairman of the Railway Companies' Association, and the Right Hon. the Earl of Bessborough, C.V.O., C.B., Chairman, London, Brighton and South Coast Railway Company, being Deputy-Chairman.

* * *

THE photograph of a Paris-Orleans express train reproduced on page 120 and on the cover of the February number was taken by Mr. W. H. C. Kelland, and not by his friend Mr. Macartney Robbins, from whom we received it.

* * *

On page 195 of the March RAILWAY MAGAZINE, by a printer's error, both of the Great Eastern river steamers there illustrated are described as the *Suffolk*. The upper view, correctly, shows the *Norfolk* off Harwich Pier, whereas the *Suffolk* is illustrated leaving Ipswich.

* * *

THE following Union of South Africa Railway officers have been relieved from their duties in order to proceed on active service:—Mr. F. H. Dutton, Superintendent (Signals), Headquarters; Mr. W. G. J. Hill, Assistant Superintendent, Headquarters; Mr. A. Herschell, Goods Superintendent, Kazerne; Mr. C. E. S. King, Cartage Superintendent, Kazerne; Mr. J. Dickson, Mechanical Engineer, Bloemfontein; and Mr. A. H. Wallis, District Superintendent, Mafeking.

IT is stated by the British Consul at Lyons, that the Schneider works at Le Creusot have constructed a naphthalene locomotive driven by a water-cooled four-cylinder motor, capable of giving 70-horse power at 950 revolutions per minute. The advantages claimed for this interesting new type of internal combustion engine are its cheapness of running and its independence of coal or water, except the small quantity required for cooling purposes. It has two carburettors, one working with ordinary petrol for starting, and the other, which is water-jacketed, for taking up the drive, by means of vaporised naphthalene, previously melted in a reservoir.

* * *

REFERRING to the Lockyer patent balanced double-beat steam regulator valve described last month, the makers, the A.B.C. Coupler, Ltd., mention that this is now the standard on the North Eastern Railway, and has been supplied in numbers to the Furness Railway. The Great Northern Railway and the Clogher Valley Railway have also fitted these valves for trial purposes. In addition these valves have been supplied the South African, Great Indian Peninsula, Bengal-Nagpur, Udaipur-Chitor, and Pekin-Mukden Railways; while designs are being prepared to suit existing boilers on several other railways.

* * *

MESSRS. JOSEPH KAYE & SONS, Ltd., inform us that since the War began they have had orders from the War Office for not less than 29,436 of their serrated seamless steel oilcans, and that, without competition, the Admiralty have renewed their three years' contract, which ended in November last. In addition to the above, they have now 7,170 oilcans on order for H.M. Navy, making a total number of oilcans ordered by the Government since the War broke out of 36,606, with 6,228 extra of their patent seamless spouts.

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Photo] [*R. C. Carter.*

LAKE SUPERIOR EXPRESS : CANADIAN NORTHERN RAILWAY.

Ready to leave Union Depot, Winnipeg, drawn by 4-6-2 superheater locomotive No. 700.

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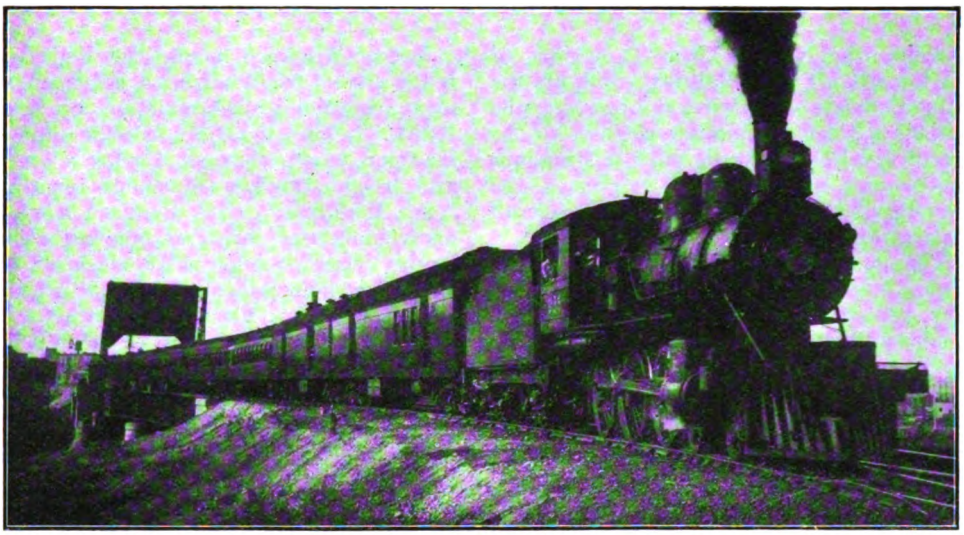

Photo] [*R. C. Carter.*

"WINNIPEG LIMITED" LEAVING WINNIPEG FOR ST. PAUL AND MINNEAPOLIS.

Winnipeg as a Railway Centre.

By NORMAN THOMPSON.

ALTHOUGH it must be admitted that Montreal is the commercial capital of Canada and its greatest railway centre, yet by virtue of its geographical position, situated as it is halfway across the Continent, Winnipeg can claim to be the most prominent point between the two oceans. Forming a gate to the West through which pours a constant stream of traffic from the States by means of the "Soo Line," this progressive city also acquires additional importance to the Canadian Pacific system as being the hub from which eight lines radiate, not including in this number the routes of other railways also concerned.

Winnipeg has made remarkable strides of late years, and it is but in keeping with the "Spirit of the West" that the passenger depôt of the original transcontinental line in the Dominion should be in consonance with this development, and the railway, recognising its opportunity, has provided a handsome and spacious edifice, worthy in all respects of the site it adorns. Dating from 1904, the existing structure presents a solid and imposing exterior, whilst within ample accommodation has been made for the wants of travellers. The waiting-hall is roomy and effectively decorated, and when the numberless incandescent electric lights are in commission, the result is a brilliant and animated scene, especially as many passengers prefer to commence a long-distance journey at night, and several important trains are arranged to start in the late evening hours.

Disposed at intervals around the walls are a number of large framed views depicting scenes in the "Rockies" and there is also a show-case containing samples of various cereals grown in the districts covered by the lines of the Canadian Pacific Railway. On one side of the main hall are to be found the dining and lunch rooms, whilst opposite are located the ticket office, news-stand and baggage room. The general offices of the railway are situated on the upper floors and extend in a wing towards the Royal Alexandra Hotel, which is one of twenty under the railway's own management. In the other direction there is a large immigration hall.

The train shed covers five tracks, three of which are "through," the others being bay roads opening to the West, and is of a reasonable height, comparing favourably in appearance with the dwarfed-structures now so much in favour in America. Facing the main entrance to the station there is a plot of vacant ground, and here an interesting relic of the pioneer days finds a resting-place,

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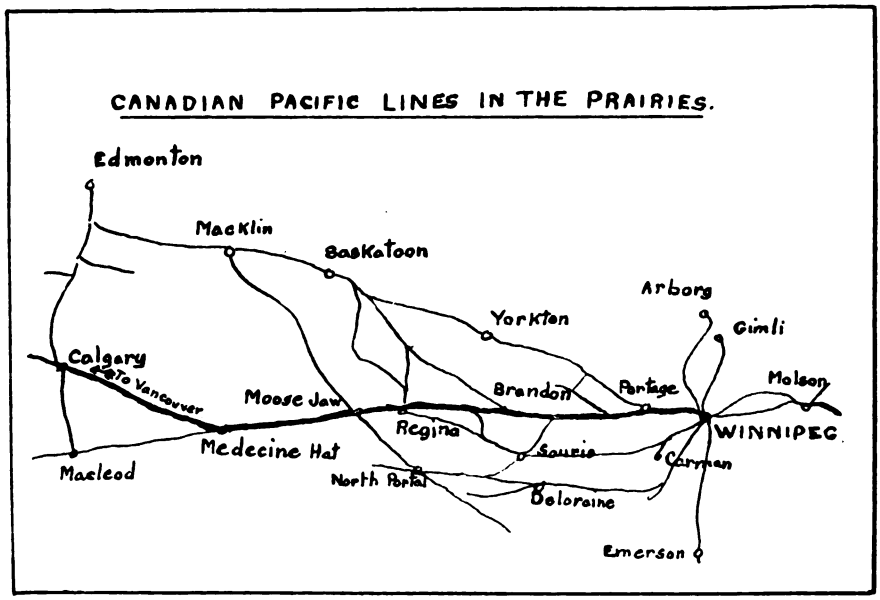
namely, the original No. 1 engine of the Canadian Pacific Railway. It bears the name *Countess of Dufferin*, and possesses the curious pattern of chimney peculiar to the era of wood-burning. Its days of strenuous labour now at an end, it carries on the framing flower-boxes, suggesting the idea of "peace after toil."

The passenger depôt is situated to the north of the central business section of the city, though the suburban region now extends well beyond the Canadian Pacific tracks. The main line enters from the east by a lattice girder bridge over the Red River, and after passing through the depôt, crosses Main Street, which is carried beneath by means of a subway in accordance with the scheme of grade separation. To the west are to be found miles of track, including car-storage sidings, and marshalling yards; here also are the shops and roundhouse. Sorting is done by gravitation, something on the lines of Edge Hill, a train of cars being pushed up a hump by a yard engine, and detached as required, a brakeman standing erect on the roof of each car as it descends and is switched on to the desired track. The surrounding district is largely occupied by stock-yards, packing-houses, and kindred industries. At Rugby, two miles out, the Gimli and Arborg branches turn off, also the lines to Souris and Deloraine, to which reference will be made later.

Facing Winnipeg, across the Red River is the city of St. Boniface, a French settlement containing a population of nearly 10,000. The Canadian Pacific line to Emerson passes through, having a station and freight trackage at about two miles from Winnipeg. St. Boniface contains many industries, including amongst others, lumber yards, rolling mills, elevators and the largest flour mills in the British Empire, and several new firms are locating there, attracted by the advantages of cheap power, good water supply, and electric lighting. Emerson is the border town on the International line, and this is the route followed by the "Soo Line" trains on their journey to the twin cities of Minneapolis and St. Paul and to Chicago.



Returning to the main line, double-tracking has been completed as far east as Port Arthur, but between Winnipeg and Molson there is an alternative route. Westbound traffic follows the line through Garson, which is seven miles longer than *viâ* Oakbank through which that in the reverse direction passes. In order to provide for the needs of the local stations on these lines, one train a day travels in the opposite direction on each route, a somewhat curious arrangement. Tracing the main line west from Winnipeg, at 55 miles the growing country town of Portage La Prairie is reached, and here the old Manitoba and North-Western

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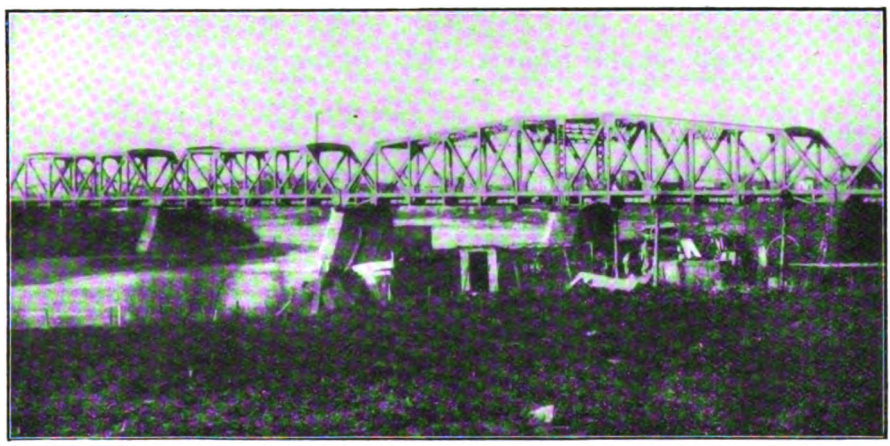
Railway diverges to Yorkton, Saskatoon and Edmonton.

Between Winnipeg and Portage there is quite a good service of trains, the total of seven in either direction being made up of four non-stops, two calling at all stations, and one having flag-stops for passengers beyond Portage. The best time in which the distance is covered is 85 min., including a climb of 90 ft. when going west. There is also a loop line forming an alternative route to Regina and points beyond, passing through Souris, and the other outlet to the west from Winnipeg is the route to Deloraine.

There remain but the two comparatively short lines reaching the lumber towns of Gimli and Arborg respectively; of these the most important is the first-mentioned, serving *en route* the popular suburban and summer resort of Selkirk, as also Winnipeg Beach on the lake of that name.



CANADIAN PACIFIC RAILWAY BRIDGE OVER THE RED RIVER.

The former is a fishing and lumber centre on the Red River at the head of lake navigation, and has sand and gravel deposits. As would naturally be expected, the train services are continually being altered and amplified to meet the needs of the growing communities that bear witness to the rapid development of the Province of Manitoba, and to-day the conditions are very different, for instance, to those obtaining say, fifteen years ago. At that time it was not unusual by any means to find trains shown as running on the branch lines but twice or three times a week, whilst the crack transcontinental train (westbound) was known as the "Pacific Express," a title that has now disappeared. Its place has been taken by the famous "Imperial Limited" and between Montreal and Winnipeg by the "Western" or "Eastern" express, according to the direction. The Vancouver express (known as the Toronto express when eastbound) runs through from Toronto to the Pacific coast, whilst two recently inaugurated expresses, the *Gate City* (when going west) and *Queen City* (eastbound) complete the list of main line through trains. Since 1898, four hours and ten minutes have been knocked off the run from Montreal to Winnipeg, whilst in that year the only connection from Toronto was *viâ* the Great Lakes and special boat express from Fort William running on certain days of the week only, and, of course, only during the season of navigation.

To the west Vancouver is nearer to Winnipeg by no less than nine hours and fifteen minutes. A great contrast is afforded by the present summer and winter services on the Gimli line, due to the residential season traffic to and from the lake resorts. Thus in December only a solitary trip is made in each direction, whilst in July there are four, arranged at times convenient to city workers. The morning business train departs from Gimli at 7 o'clock and is due into Winnipeg at 8.45, with six regular and one or two extra flag stops, the distance being 58 miles. Returning there are two convenient trains at 17.20 and 18.30 respectively, for the 24-hour notation is in use west of Lake Superior. The second of these terminates at Winnipeg Beach. The Arborg line, which is 76 miles in length, gets only one train making the whole

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journey, but another one runs as far as Teulon, about halfway.

Traffic commences at the Winnipeg depôt at 7 and the day's work finishes with the departure of the 23.40 to the West. Altogether, the total number of trains arriving and departing on an ordinary winter's day of 24 hours is 44.

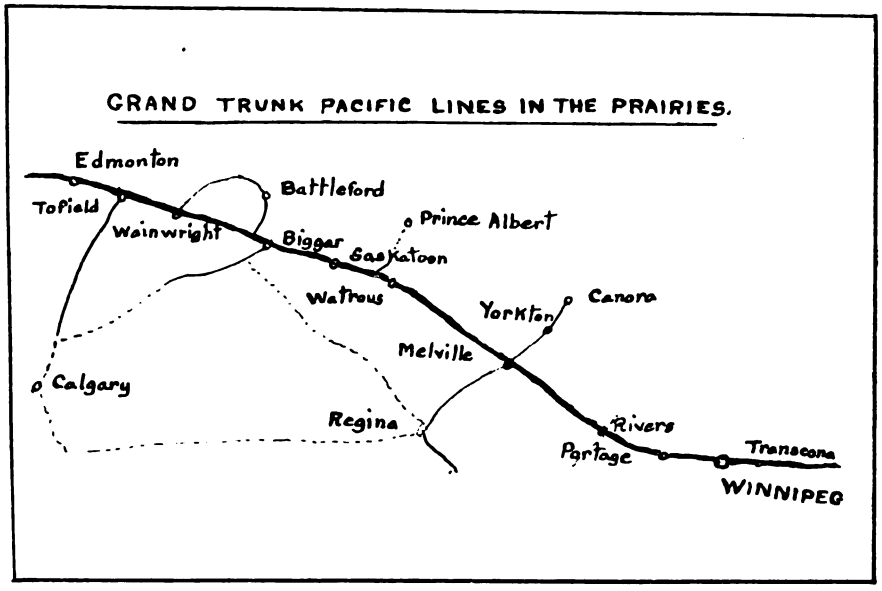
Until the completion of the National Transcontinental Railway, the prairie lines of the Grand Trunk Pacific were severed from direct connection with the parent system in Eastern Canada, but communication is now open right through from Winnipeg to Prince Rupert, and a regular train service is in operation. For these trains up-to-date sleeping, dining, parlour and day coaches are used, and the service connects with the Grand Trunk Pacific steamers operating from Prince Rupert to Vancouver, Victoria and Seattle.

The branch line from Tofield to Calgary is completed, and trains are operated regularly over this section, as also from Winnipeg to Regina. At this place, and at Edmonton, the Grand Trunk Pacific Railway are building hotels comparable with those at Fort Garry, Winnipeg, and the Chateau Laurier, Ottawa. In all there are now over 3,000 miles of line west of Lake Superior, with some 300 miles additional under construction.

The handsome new Union passenger depôt in Winnipeg is used by the trains of the Grand Trunk Pacific Railway, and the approach thereto from the East has entailed some heavy engineering work. Coming from the direction of Transcona, where the shops are situated, the line is carried on an embankment with steel bridges and viaducts spanning the Canadian Pacific Railway, a creek and the Red River and streets of the city. Going West, the Canadian Northern Railway bridge over the Assiniboine River is utilised. The train service to the West will first be considered.

There are now two daily through trains from Winnipeg to the west. No. 3 is a slow train scheduled to leave Winnipeg at 9 a.m., and runs as far as Watrous, 408 miles, reached at 10.45 p.m.

The " Limited " No. 1 departs from Winnipeg at 6 p.m. and calls nine times to Watrous, reached at 6.15 a.m. Thence it serves all the roadside stations, except for the last 41 miles from Tofield to Edmonton, on which section the local work is done by a train off the Calgary branch. It is continued from Edmonton to Prince George only on Sundays, Tuesdays and Fridays, the two former services being extended through to Prince Rupert. It is then semi-fast to Edson, there being a daily local train on this division, and beyond calls at every station. This train carries the highest class of equipment, including electric-lighted berths in the sleepers, drawing-room accommodation and dining cars. By the train leaving Winnipeg at 6 p.m. on Monday



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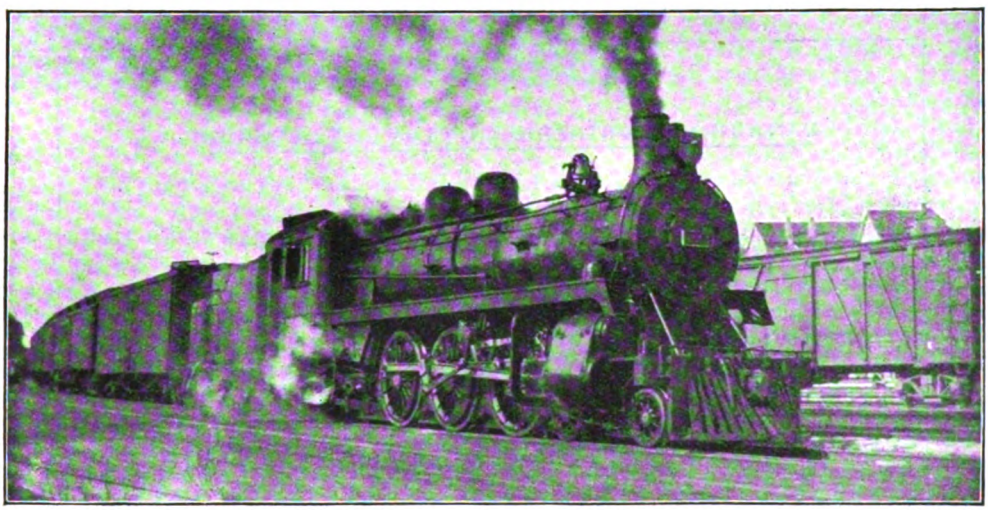
Prince Rupert (1,745 miles) is reached at 6 p.m. on Thursday, without making allowance for change from Central to Mountain time on the way.

Turning to the East, the service that is in force all through the year is somewhat scanty, although it has been supplemented during recent summers. Mixed trains start from both Winnipeg and Fort William on Mondays, Wednesdays, and Fridays, and spend the night at Graham, situated 197 miles from the latter terminal, the whole distance being 448 miles. The return journey is made next day, this arrangement necessitating the through passenger spending the night at Graham. Regular or flag stops sometimes skipping a divisional point (which was usually named in some other manner) and then recommencing again at the first letter. In many instances, the population is exceedingly small; thus Birmingham boasts a total of 25 souls!

Returning, however, to the Fort William service. In June, 1913, a tri-weekly through train was put on, shortening the time on the whole journey by many hours, and calling only four times with three additional flag stops. This train departed from Winnipeg at 10.30 p.m. on the days when the 7.30 a.m. "mixed" did not run, and a similar train was provided in the reverse direction. There was also at the same period yet



Photo] [*F. Sakis.*

CANADIAN PACIFIC RAILWAY.

New 4-6-2 locomotive leaving Kenna, with No. 2 "Imperial Limited" Express.

are made at all intermediate stations, and in view of the frequency with which the latter are resorted to in planning the schedules, it may be of interest to refer to the instructions given in the time-table folder concerning signalling. At places where no agent is on duty, passengers wishing to board a train are expected to make use of flags by day and lamps by night, displaying one white and one green from the time that the train whistles for the station until it is evident that the engineer has observed the signal, when the flags or lamps are to be returned to the waiting room.

Roadside stations having been created by the advent of the railway are in some cases named alphabetically in order along the line, another local on Friday afternoons, terminating at Redditt, 128 miles, and returning next morning; this train made only four flag stops eastbound, and covered the distance in four hours exactly, occupying slightly longer in the reverse direction.

An important event in the history of the Grand Trunk Pacific Railway's development in Winnipeg was the opening with much *eclat* on December 10th, 1913, of the Fort Garry Hotel. Located quite close to the Union depôt, and fronting on Broadway, the new structure is a landmark for miles round. It is beautifully fitted up and, both in internal appointment and external appearance, forms a worthy addition to the number of hotels under the management of the Railway.

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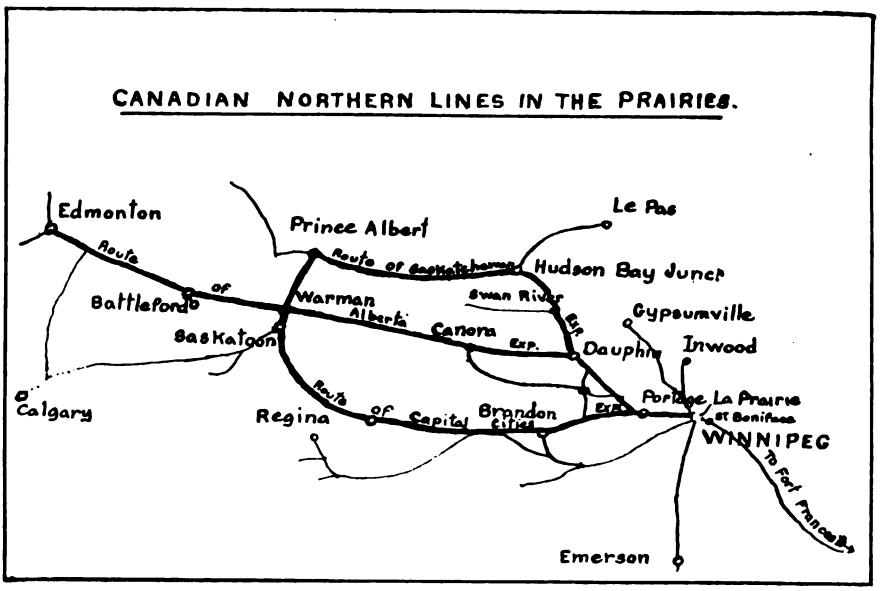
The progress made by the Canadian Northern Railway in covering with a network of lines the prairie provinces of Manitoba, Saskatchewan and Alberta, can only be described as remarkable. The connecting link with the Ontario and Quebec lines is not yet ready for traffic and the Eastern terminal point is at present Port Arthur. In the West, however, development has proceeded much more rapidly, and although a great deal remains yet to be done, nearly all the more important cities and towns have been linked up by means of the three trunk lines and their interlacing branches.

The main line which extends from Winnipeg by way of Dauphin, Canora, Warman which point a railway is under construction to Hudson Bay itself. The remaining Canadian Northern lines centreing on Winnipeg are those leading to Brandon *viâ* Carman, to Emerson (giving an entry into the city for the Great Northern and Northern Pacific Railways from over the border), to Port Arthur, and Duluth *viâ* Fort Frances, and three short branches which will be considered later.

The handsome Union depôt in Winnipeg has been erected on the site of historic Fort Garry, the sole surviving portion of which is an old gateway, that can still be seen behind the hotel of that name. The octagonal entrance hall is flanked on either side by wings containing on the ground floor the



(Junction for Saskatoon) and North Battleford to Edmonton where it now ends, is ultimately to be pushed right through to the Pacific in the neighbourhood of Vancouver. The Southern loop line diverges at Portage La Prairie and serves the former Canadian Pacific preserves of Brandon and Regina, regaining the first route at Warman after passing through Saskatoon, and continuing northward to Prince Albert. The latter town can also be reached by the "Saskatchewan Valley Route," leaving the main line at Dauphin, where a fine new station has been erected, and passing through Hudson Bay Junction, whence a branch is thrown back to Le Pas, from

waiting and dining rooms, the general offices of the two railways being accommodated on the upper floors. The exterior is dignified but somewhat severe in the simplicity of its style, and the situation, with the main archway looking straight down the tree-lined Broadway, is excellent. The switching engines employed at this depôt are provided by the Canadian Northern Railway, but are leased to the Joint Terminal Committee.

The practice of describing any long-distance passenger train as "express," and of providing it with a catchy title, whilst no doubt of great assistance in gaining publicity, leads to results that seem curious to those not acquainted with Western

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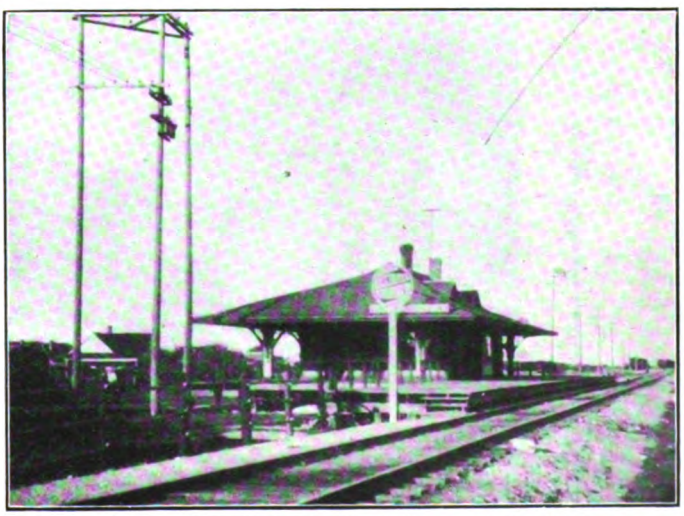
CANADIAN PACIFIC RAILWAY YARD AT WINNIPEG.
From Salter Street Bridge, looking West.

methods. For instance, the "Capital Cities Express" which runs between Winnipeg and Prince Albert *viâ* Regina, is for a distance of 300 miles, the only daily passenger train on the line, and consequently serves every intermediate station, which means making no less than 18 regular and 27 possible flag stops. This train has also been subjected to some startling changes of schedule. Thus in June, 1911, it was booked to leave Winnipeg at 11 a.m., reaching Regina at 11.45 p.m. and Saskatoon at 6.47 a.m. next day. By February, 1912, the time of departure had been altered to 3 p.m., whilst it has now been for some time five hours later.

The "Alberta" and "Saskatchewan" expresses, which are routed, respectively, *viâ* Canora and Swan River, are trains of a similar type. These three all take the same course between Winnipeg and Portage La Prairie, the "Capital Cities" making the best time and achieving a speed of 39 miles per hour eastbound from Portage to Carman Junction, a distance of 46¾ miles. A longer non-stop run is that made by the "Lake Superior Express," between Giroux and South Junction, 54¾ miles in 100 minutes. In addition to serving Fort William and Port Arthur this train carries through cars for Duluth, detached at Fort Frances, whence they run over the Duluth, Winnipeg and Pacific Railway.

The Canadian Northern is still extending its lines in all directions and the development of the Oak Point section may be described to indicate what is going on all over the system.

In 1911 this branch only reached Oak Point, 66 miles from Winnipeg, and a train was provided in either direction six days a week. A few months later the passenger service was extended to the terminus at the Gypsum Mines by Lake Manitoba, and the through train ran on alternate days only, being supplemented by a local from Oak Point to Winnipeg, also tri-weekly, which, however, returned the same day. Gypsumville is 162 miles from Winnipeg. To-day, the branch from Grosse Isle is open as far as Inwood, and one train travels down each line on Mondays, Wednesdays and Fridays, returning the following days.



WESTSIDE STATION: CANADIAN NORTHERN RAILWAY.

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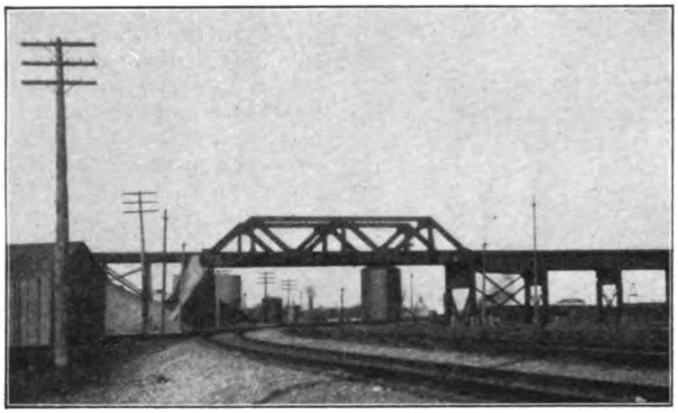
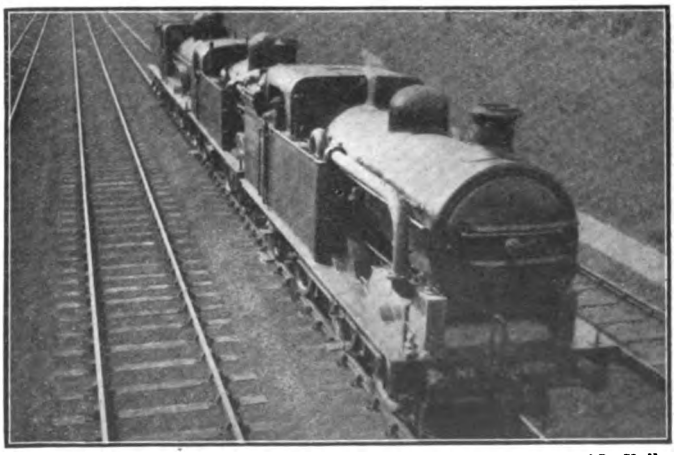


BRIDGE CARRYING THE GRAND TRUNK PACIFIC RAILWAY OVER THE CANADIAN PACIFIC RAILWAY EMERSON LINE AT ST. BONIFACE.

Winnipeg passengers are required to join and leave these trains at "Westside," a suburban station located rather remotely from the centre of the city on Portage Avenue, although they actually run *viâ* Portage Junction to the yards at Fort Rouge, where, by the way, the Canadian Northern have installed some well-equipped shops, round-house, etc. Lastly, there is the Fort Alexander line, which is now open for freight traffic between Paddington and Birds Hill, 8¾ miles.

Paddington is the junction with the Fort Frances line, and is situated a little more than two miles from Winnipeg, in the vicinity of the Union stockyards at St. Boniface. The number of Canadian Northern trains entering and leaving the Union depôt daily is 16, not including those of the Great Northern and Northern Pacific Railways, whose freight depot is reached over the Midland Railway of Manitoba, a new line which does not deal in passenger traffic at present.

Going to Doncaster for Repairs.



Photo] [*R. Hall.*

This unusual view shows a series of Great Northern locomotives on their way to Doncaster Works for repairs and overhaul.

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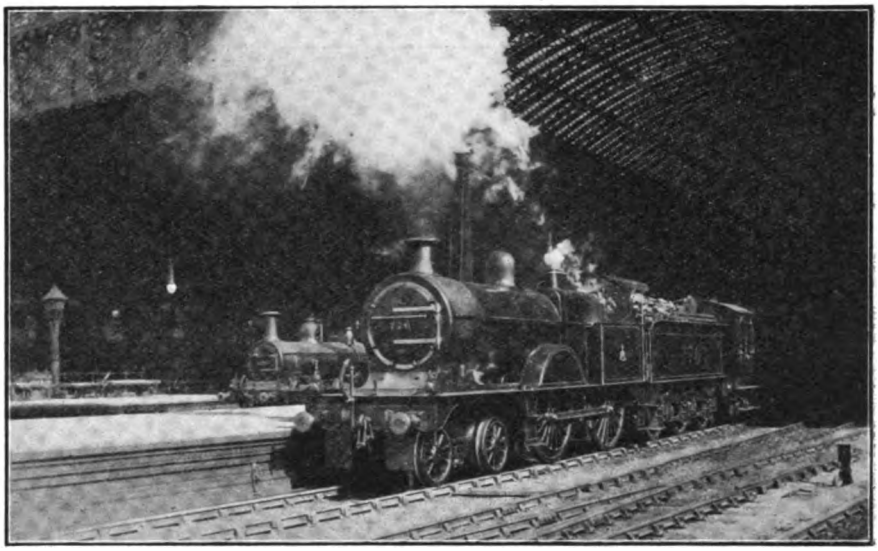

Photo] [*H. G. Cogger.*

MIDLAND RAILWAY.

Express leaving No. 3 platform at St. Pancras.

4-4-0 locomotive No. 776.

British Locomotive Practice and Performance.

By CECIL J. ALLEN.

IN the last two issues we have had under review the question of time-keeping under abnormal circumstances, which divided themselves into two classes—delays and exceptional loads. Discussion of these points has called forth some interesting comments from the correspondent whose run on the Great Western Railway "Riviera Limited" appeared in last month's article. As regards the making up of time lost through delays, he remarks: "Though the discouragement of making up time is partly due to the fear of accidents which might be caused by excessive speed, yet by far the largest class of accidents—collisions—is for the most part due to unpunctuality. If every train could be depended on to run absolutely to time always, then (assuming the time-table to have been properly framed) there would be no collisions through mistakes connected with signals. These mistakes only become dangerous when trains are not running at their proper intervals, and have to be restored to them, *i.e.*, when they are *unpunctual*. Thus the unpunctuality which is acquiesced in so as to avoid one class of accidents is all the time landing us in accidents of another kind, perhaps to an even greater extent." This is an interesting point, and it is certainly the case that, if the records of accidents which have occurred during recent years be examined, quite a number of disastrous collisions have been directly due to the late running of either the standing or the colliding train. On the other hand only one serious accident during the last decade—the derailment at Salisbury in 1906—was attributable to reckless running in an attempt to make up lost time.

In connection with abnormal loads, my correspondent writes: "Of course, if, whenever coaches are added to a train, the drivers still keep time with it, there must be a temptation to go on adding coaches indefinitely, which is hard on the men; there must be a limit somewhere, and the position for the drivers is rather awkward." This also is true to some extent, and is a matter to which those responsible for the working of the traffic might reasonably pay closer attention. Maximum loads are rigidly

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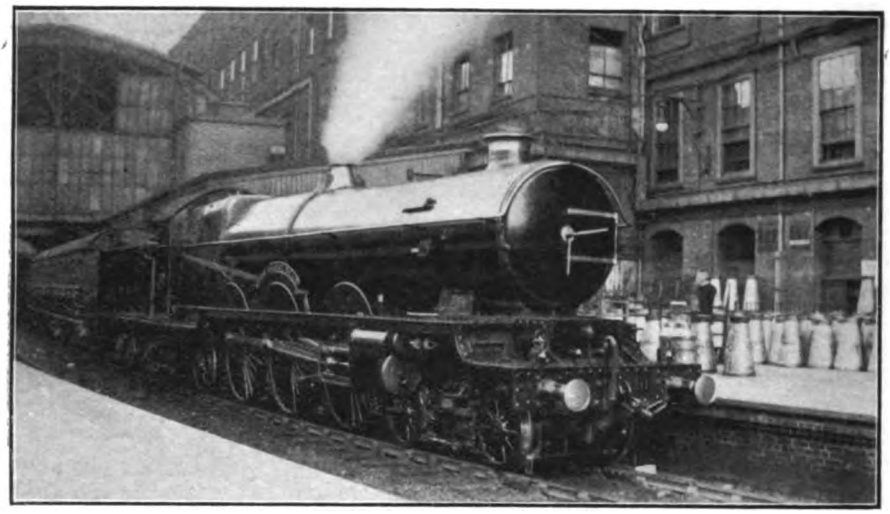

Photo] [*H. G. Cogger.*

GREAT WESTERN RAILWAY.

6.40 p.m. Bath and Bristol express at Paddington.
4-6-2 locomotive No. 111, *The Great Bear.*

adhered to in the operation of goods traffic, on account of braking and other considerations, and it is only fair to both drivers and firemen—perhaps the latter even more than the former—that there should be in passenger train working also a "limit somewhere." The nearest approach to this "limit" is found in the practice of the Midland Company, which specifies in its working book a maximum load for each of the four different classes of engine employed, on every express train. Moreover these limits are, on the whole, carefully observed, as it is exceptional to see any excess over the specified maximum without a pilot engine being allowed. On the London and North Western and other lines each type of express engine has its maximum load specified, but this is hardly so satisfactory a method, as no allowance is made for the comparative difficulty of the schedules. Presumably these *maxima* are framed to embrace the most difficult bookings. My friend, by the way, instances another earlier trip on the "Riviera Limited," which he aptly describes as a "foil" to the one published last month. On this run, with a 2-cylinder 4-6-0 "Saint" and a load of 405 tons (all of which went through to Plymouth), "the driver was out, not to do his best, but simply to comply with requirements." Thus Taunton was reached in 151½ min., or practically as booked, but, although the load was 60 tons less than the one mentioned in the last issue, a stop was made there for a pilot up Wellington Bank, and another stop at Whiteball Summit to detach it. A further halt followed at Newton Abbot for a pilot to Plymouth, which was reached 19½ min. late. This could not, of course, be described as a "bad" run, in view of the load conveyed, but it illustrates the variation in the work of different drivers in their treatment of abnormal circumstances.

We come now to the question of hill-climbing, which is also intimately connected with the subject of time-keeping. It is hardly possible to describe exceptional grades as an "abnormal condition," of the same character as exceptional loads, or exceptional running delays. For, whereas the latter are more or less occasional happenings, the adverse grades of a main line, whether slight or severe, are permanent hindrances to fast running. Consequently the schedules of express trains are fixed with a certain regard to the difficulties of the route traversed. But there is a connection between adverse grading and time-keeping, and it is found in the character of the uphill work of different drivers and different types of engines. Locomotive hill-climbing in theory one finds to be a subject entirely distinct from locomotive hill-climbing in practice. That is to say, any deductions that one might draw from the relative cylinder and steam-raising capacities of locomotives are frequently entirely at variance with the performance of the same engines on adverse gradients. For this result many causes other

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than design may be responsible, and probably two of these causes are of paramount importance. As with the recovery of lost time, or the handling of abnormal loads, one of them is the tradition of the company concerned, and the other is the practice of the individual driver.

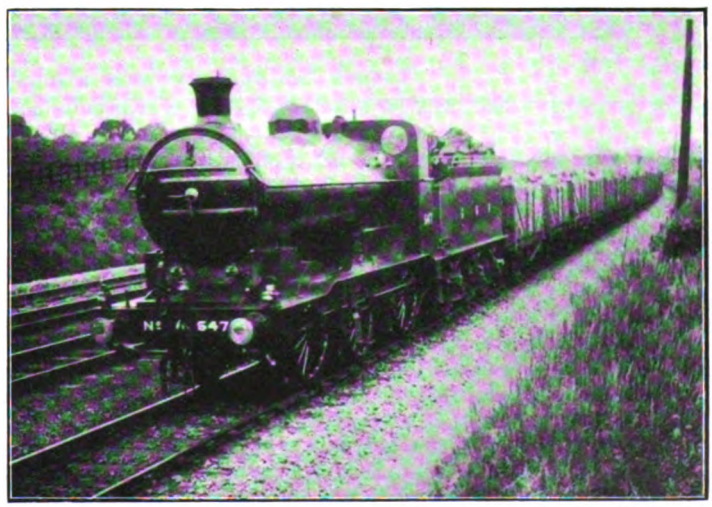
Grading is, undoubtedly and more than any other factor, *the* controlling factor in railway operation. Directly a locomotive with its train enters upon an adverse gradient it has to contend with the pull of gravity in addition to the ordinary internal and external resistances—frictional and atmospheric—due to its motion. How very rapidly the work required to be performed by an engine—speed being maintained at a constant level—increases with but moderate increments in the gradient is best shown by the annexed table :—

FORCE IN LBS. REQUIRED TO MOVE EACH TON OF TRAIN BEHIND THE TENDER :—

Speed m.p.h.	On the level.	Up gradient of		
		1/300	1/100	1/67
	lbs.	lbs.	lbs.	lbs.
20	6·5	17·7	28·9	40·1
30	8·1	19·3	30·5	41·7
40	10·8	22·0	33·2	44·4
50	13·8	25·0	36·2	47·4
60	17·5	28·7	39·9	51·2

Further, the down grades of an undulating road do not compensate for its up grades, in this sense, that time lost with heavy loads by slow running uphill is not regained on a succeeding downhill stretch save by running over the latter at an altogether disproportionately high speed. For example, if the scheduled speed of an express between passing two points, say, 20 miles apart, is 55 miles per hour ; if the line rises in either direction for 10 miles at 1 in 200 to a summit point midway between the two towns ; and if the average speed of a heavy train up the 10 miles to the summit is 40 miles per hour ; then the *average* speed down the succeeding 10 miles' descent must be 88 miles per hour, which means a maximum of well over 90, and is, of course, altogether outside the region of practical politics. Thus locomotive hill-climbing is really more or less a key to the whole situation on heavily-graded lines.

The tendency on most British lines at the present time is in the direction of improved uphill work, and the avoidance of excessive speeds downhill. As I remarked a couple of months ago, there is no danger, on a well-laid and well-aligned modern road, in the very highest speeds of which the steam locomotive is capable, but obviously uniformity in running is as desirable as uniformity in every other direction. Working time-tables sometimes carry the uniformity principle to extremes, inviting drivers to attempt impossibly fast uphill times and then to restrain their fiery steeds to a mere amble of some 55 miles an hour on long and tempting downhill stretches. I could name many examples of such time-table practice. In one rather notorious case the standard express times from London out to the first important junction station (where passing times are given) are habitually exceeded by anything from 3 to 7 min.—I have known it as much as 10 min.—with heavy trains, while a down hill stretch further on in the journey is generally covered in from 3 to 5 min. under the working allowance. This is a case where the requirements of the working book have been so extravagantly framed as almost to preclude observance. The result is that many of the intermediate booked



Photo] [*R. Hall.*

GREAT NORTHERN RAILWAY.
Up coal train near Wymondby.
New 0-6-0 superheater engine No. 547.

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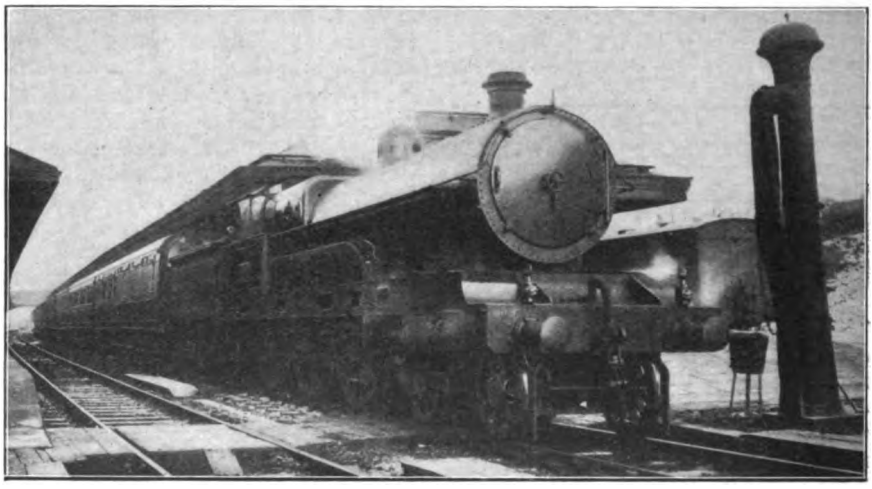
passing times of the expresses are quite valueless. This is a pity, as local unpunctuality of this character invariably leads to general unpunctuality, whereas a reasonably-framed working book, with moderate uphill and downhill times, and a strictly-enforced observance of them, is bound to improve the punctuality of the system as a whole.

It may be argued that fast uphill running is an unduly extravagant proceeding, so far as the consumption of fuel and locomotive wear and tear are concerned. Indeed, unduly fast work uphill and unnecessarily slow running downhill may even have harmful effects upon the locomotive itself, as when the engine is "eased" considerably after passing the summit of the bank, tubes and stays are liable to start leaking as a result of the fall in temperature in the firebox, caused by the reduced rate of fuel consumption. But this, of course, is an extreme aspect of the case, and no such trouble is likely to occur unless the engine be immoderately thrashed on the adverse gradients. On the other hand, with the schedules of expresses at a constant figure, as they have remained now, generally speaking, for the last decade, the improved uphill work rendered possible with the modern locomotive gives the driver a margin in view of the possibility of *en route* delays. That is to say, it is practicable to run at moderate downhill speeds under normal circumstances, whereas, if delays be experienced, the high downhill speeds of which the engines are capable are, so to speak, "in reserve," for use when the regaining of time is necessary. But, where the uphill work is poor, and time is lost thereby, no such margin exists, with the result that under all circumstances the speeds on the falling grades must be very high, while any delays will effectually preclude the possibility of keeping time. Briefly put, the "margin" gained from good hill-climbing consists in the *possibility* of high speeds on falling gradients when necessary, rather than the *practice* of very fast running downhill on all occasions.

The deductions that one would naturally draw from the foregoing remarks are fully borne out in the average of actual running. In my own experience, the lines on which the speed of express trains uphill is the poorest are notorious for bad time-keeping. On the other hand, it is an indisputable fact that the lines famed for the excellence of their hill-climbing are equally noted for the recovery of lost time and correspondingly punctual running. The former method tends towards economy in maintenance and running costs, while the latter may prove the more expensive; consequently, modern express locomotive practice aims at finding the ideal "mean" between the two extremes. At the same time it certainly inclines in the direction of improved uphill work, which, as we have seen, is from the time-keeping standpoint not only a desirable, but also a necessary feature of working. Whether the latter practice be encouraged or discouraged



Photo] [*W. H. C. Kelland.*

LONDON AND NORTH WESTERN RAILWAY.

No. 2222, *Sir Gilbert Claughton*, on express train at Carnforth.

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by the responsible authorities, however, the quality of locomotive hill-climbing is governed—in almost the same degree as the regaining of lost time or the management of abnormal loads—by the character of the men on the footplate.

I had intended giving in this issue a table illustrating the comparative difficulties of grading of each of the principal main lines out of London, but in order that the space available for dealing with performance may not be too drastically curtailed, I am holding this over until the next issue. The most interesting feature of this tabular statement is the way in which it shows that each of the main lines to the north has been planned with more severe grading than the one before it, in chronological order of construction. Consequently the last-comer—the Great Central Railway—has the most serious difficulties of all with which to contend, and it is, therefore, fitting that we should take a series of runs on the Great Central main line as an example of modern hill-climbing work. The average loading of Great Central expresses is, of course, light, but, in consideration of the ascents to be surmounted, the point to point timings of these trains are without question the most remarkable that the country has to offer in the matter of speed. Moreover, now that the new and exceedingly heavy 60 ft. stock is in use on the principal trains, these are by no means as light as they were when the times were framed. The 2.15 p.m. express from Manchester to London, with which I wish to deal principally, has—or had, until the "war" curtailments—five of the biggest eight-wheelers from Penistone onwards, while a substantial load of fish in eight and four-wheeled vehicles, through from Grimsby to London, is added at Nottingham. Thus the weight of this train from Nottingham onwards is always well over 200 tons.

As to the point-to-point bookings, these are difficult throughout. The 49 min.

GREAT CENTRAL RAILWAY—SHEFFIELD-LEICESTER.

Distance (miles & chains)	Schedule Time (mins.)	Engine: 4-4-2, No.	1 261	2 ‖1102	3 261	4 §262	5 1093	6 263	Schedule Time (mins.)	7 261
		Load to Nottingham (tons)	155	180	180	180	180	145		165
		Load from Nottingham (tons)	195	250	230	230	220	215		165
0 0	0	Sheffield .. dep.	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
1 59	—	Darnall .. .. pass	4.00	4.20	4.50	4.35	4.40	4.10	—	4.27
			p.w.r.	p.w.r.						
4 71	—	Woodhouse .. „	8.20	9.35	8.20	8.05	8.25	7.35	—	7.42
12 2	—	Staveley .. „	16.40	17.50	16.35	16.05	16.35	15.40	—	15.30
17 70	—	Heath .. .. „	25.30	26.20	26.40	24.40	25.50	23.40	—	24.02
										p.w.r.
26 37	—	Kirkby .. .. „	35.40	36.35	36.50	34.35	sigs.	sigs.	—	33.43
32 31	—	Hucknall .. „	41.50	43.00	43.05	40.35	sigs.	sigs.	—	39.39
				sigs.						
38 14	49	Nottingham .. arr.	48.35	50.25	50.15	47.05	55.45	55.20	50	46.25
4 32	—	Ruddington .. pass	6.30	6.25	6.15	6.20	6.25	6.15	—	6.16
				p.w.r.						
9 2	—	East Leake .. „	11.30	12.25	11.25	11.20	11.20	sigs.	—	11.27
13 48	—	Loughborough „	16.05	17.20	16.10	15.55	15.50	sigs.	—	15.39
18 35	—	Rothley.. .. „	20.55	22.35	21.15	20.35	20.30	sigs.	—	20.28
			p.w.r.							
23 35	26	Leicester .. arr.	27.35	28.20	27.05	25.55	26.10	—	26	25.39
38 14	49	Net time, Sheff.-Notts. (mins.)	49¾	48	50¼	47	48½	46	50	46
23 35	26	Net time, Notts.-Leicester (mins.)	26½	27	27	26	26¼	26	26	25¾
61 49	75	Total net time (mins.)	74¼	75	77¼	73	74¾	72	76	71¾

§ Superheater engine. ‖ 4-6-0 type. Thick horizontal line indicates booked stop.

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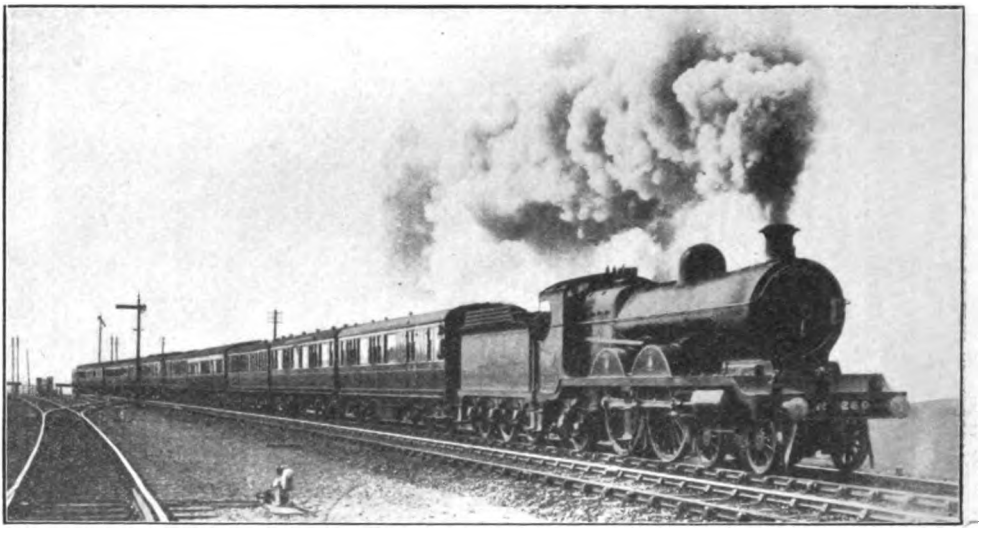
allowed for the 38 miles 14 chains from Sheffield to Nottingham is the fastest booking of the day for this stretch. But it is perhaps the easiest timed section of the journey, although it includes an unbroken climb of 10 miles from Eckington to Pilsley, of which the 6¼ miles from Staveley to just beyond Heath are almost entirely at 1 in 100. The working book apportions 6 min. out of the 49 to "permanent way cautions" between Sheffield and Nottingham, but this must be taken very much *cum grano salis*, as in the first place there are practically no serious cautions of a permanent character at present in operation, while on the other hand it would be practically impossible over from the start there is a bank of over 9 miles, mainly at this inclination, while from Braunston to Charwelton the line rises for 6½ miles continuously at this figure. The vertical rise from Leicester to Woodford is no less than 475 ft. From Woodford to Brackley only 13 min. are allowed to the fresh start, leaving a running time of about 12½ min. for a sharply undulating distance of 9 miles 65 chains—again a very tight allowance. On to London the booking of 67 min. for the final 59¼ miles is not unduly hard, the only serious difficulty being the long rise from Aylesbury to Amersham, beginning with some 6 miles at 1 in 117 (and a further 1 at easier grades) and finish-



Photo] [*W. Bradshaw.*

GREAT CENTRAL RAILWAY.

8.45 a.m. London-Manchester restaurant car express passing Abbey Lane box, Leicester. With through portion from Oxford to York attached at rear (from Leicester). 4-4-2 locomotive No. 260.

this road, with an aggregate vertical rise of 570 ft., to complete the journey in 43 min. From Nottingham to Leicester the timing of 26 min. for the 23 miles 35 chains is exceedingly tight, as the table of runs shows. Almost exactly half the distance is on adverse grades, of which some 6 miles are at 1 in 176. So the inclusive average speed of 54·1 miles per hour has to be maintained over a section of line with a vertical rise of 270 ft. Still more difficult is the 34 miles' stretch from Leicester to Woodford, with only 38 min. allowed—a start-to-stop average of 53·7 miles per hour—for no less than 19½ miles of this distance are adversely graded, including 14½ at 1 in 176. Right ing, after a smart 3 miles' fall past Missenden, with a mile up at 1 in 344 and 2¼ at 160. The serious slack at Rickmansworth, and the less severe ones at Grendon Underwood, Quainton Road and Harrow are also hindrances to a high average speed. Altogether, therefore, very hard locomotive work and first-class hill-climbing are needed on this train—as on almost every train on the Great Central Railway London Extension, of which this is but representative—if time is to be kept.

In order that the table of runs may not be too unwieldy, I have divided it into two parts, the first running from Sheffield to Leicester, where engines are changed, and

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the second from Leicester to London. The runs are all continuous, however, the first six relating to the 3.25 p.m. express from Sheffield to London, and the seventh—forwarded to me by the kindness of a correspondent—to the 8.48 a.m. express *ex*-Sheffield. The timing of the latter train closely corresponds to that of the former, save that 1 min. more is allowed to Nottingham, and 2 min. less from Leicester to Woodford—a "counsel of perfection," this! occasion of this run, by the way, the train was delayed for an hour on starting owing to trucks being off the road outside Sheffield, and this, therefore, furnishes a noteworthy example of regaining lost time, as the engine recovered 10 min. on these fast running times between Sheffield and London. For the sake of those who know the engines better by name than by number, it may be mentioned that the locomotives in the second parts of runs 4, 5 and 6—all of the new

GREAT CENTRAL RAILWAY—LEICESTER-MARYLEBONE.

Distance (miles and chains.)	Schedule Time (mins.)	No. of run	1	2	3	4	5	6	Schedule Time (mins.)	7
		Engine No.	1088	1093	1092	430	*431	435		261
		Type	4-4-2	4-4-2	4-4-2	4-4-0	4-4-0	4-4-0		4-4-2
		Load (tons)	195	250	230	230	220	215		165
0 0	0	Leicester .. dep.	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
4 57	—	Whetstone .. pass	7.00	7.15	7.45	7.20	7.20	6.50	—	6.42
9 15	—	Ashby Magna .. „	12.30	12.50	13.45	12.50	13.20	12.00	—	12.04
13 6	—	Lutterworth .. „	17.10	17.30	18.40	17.20	18.35	16.20	—	16.42
19 69	—	Rugby .. .. „	22.55	23.30	24.45	23.10	25.05	22.15	—	22.49
24 44	—	Braunston .. „	26.40	27.35	28.55	27.05	29.20	26.10	—	26.58
31 47	—	Charwelton .. „	34.45	35.50	37.00	35.00	37.05	33.50	—	34.40
										sigs.
34 1	38	Woodford .. arr.	38.10	39.20	40.10	38.10	40.20	37.00	36	†38.19
9 65	12½	Brackley .. arr.	12.15	12.25	12.55	13.05	11.55	11.55	—	11.27
4 64	—	Finmere .. pass	6.10	6.25	6.10	6.25	6.15	6.05	—	15.48
12 34	—	Grendon Jc. .. „	12.25	12.50	12.25	12.50	12.55	12.50	—	21.50
14 71	16	Quainton Rd. Jc. „	15.00	15.30	15.05	15.30	15.40	16.05	25	24.08
21 25	23	Aylesbury .. „	21.10	22.05	21.25	21.40	22.15	22.55	32	30.07
25 77	—	Wendover .. „	26.25	28.20	26.50	27.10	28.15	28.45	—	35.40
30 36	—	Gt. Missenden .. „	31.40	34.30	32.15	33.00	33.55	34.20	—	41.02
35 50	—	Amersham .. „	36.25	39.45	37.00	37.50	38.55	39.20	—	45.50
39 70	—	Chorley Wood .. „	40.25	44.00	40.55	42.00	42.50	43.10	—	§50.00
							p.w.r.	p.w.r.		50.13
42 5	46	Rickmansworth „	42.20	46.05	43.30	44.25	45.20	45.45	55	53.57
45 44	—	Northwood .. „	46.35	51.05	48.05	49.00	50.10	50.40	—	58.15
50 2	55	Harrow .. „	50.55	56.00	52.25	53.45	54.50	55.30	65	62.39
54 38	—	Neasden Jc. .. „	55.15	60.45	57.00	58.05	59.10	59.50	—	66.54
			p.w.r							
59.21	67	Marylebone .. „	‖62.25	69.00	64.00	64.55	††66.15	¶67.00	77	‡73.30

* Woodford-Marylebone only; No. 112 (4-4-0) Leicester-Woodford. § Signal stop 13 sec.
† 37¾ min. net. ¶ 66½ min. net. ‡ 71½ min. net. ‖ 62 min. net. †† 65¾ min. net.
Thick horizontal line indicates booked stop.

—while no stop is made at Brackley. From Woodford to Marylebone the timing has about the same difficulty as that of the evening train from Brackley, the extra minute from Aylesbury onwards compensating for the tightness of the allowance from Woodford to Quainton Road. The engine in the latter instance worked through to London, the load being also unchanged, and thus considerably lighter from Nottingham onwards than on runs 1-6. On the superheater "Director" class—bear respectively the names of *Purdon Viccars*, *Edwin A. Beazley* and *Sir Clement Royds*.

Taking first the Sheffield-Leicester table, we find that the 4-4-2 engine No. 261 figures in three runs. On the first the start was particularly smart, as Darnall, 2 miles out, was passed in 4 min. exactly, despite the continuous rise at 1 in 144-155 from Sheffield, but a permanent way check was experienced at the tunnel works, then in

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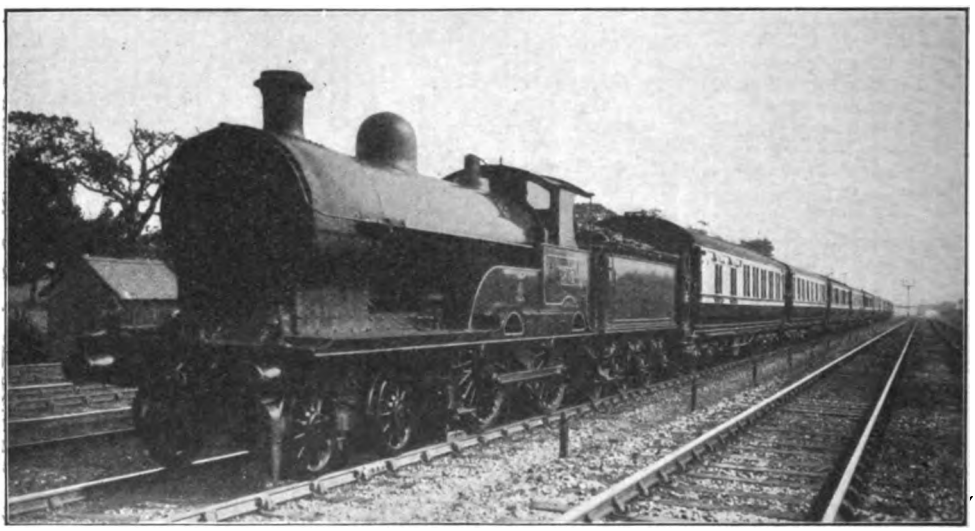
progress. Thenceforward the run had no special features, and time was kept without difficulty. On No. 2 run the engine was a 6 ft. 6 in. 6-coupled, and the load the now standard figure of 180 tons. The Darnall check in this case was much worse, and lost us some 1¾ min., but good work was done from Staveley up to Heath, and despite a signal check at Carrington, we dropped less than 1½ min. on the booking. We were again hauled by No. 261 on the third run, which was decidedly poor, especially at the start and on the ascent from Staveley; 1¼ min. were lost on schedule. No. 4 was a splendid run between Sheffield and Nottingham, the engine being superheater-equipped, and driven by Armstrong. The uphill time from Staveley to Heath was good, while the descent from Heath to Nottingham was exceptionally fast, the 20 miles 24 chains taking only 22 min. 25 sec., so that 2 min. were gained on schedule. No. 5 run started poorly, the work up to Heath in particular being feeble; from Holm Wood onwards, however, a string of signal checks was encountered from the preceding Cleethorpes train, which checked us throughout into Nottingham.

The last run of my series opened brilliantly, and bade fair to be a record, as the time of 23 min. 40 sec. out to Heath is the fastest I have ever obtained, as also the very fine time of 8 min. from Staveley to Heath —an average of all but 44 miles per hour on the 1 in 100 climb. No lower speed than 40·9 miles per hour was touched. Unfortunately the same checks followed as on the previous run—in this case from a preceding "special" from the North Eastern line to Leicester—and we lost time seriously. No. 7 was another magnificent run, Bell in this case being the driver of No. 261. The speed from Darnall summit down to Woodhouse was rather faster than usual, as also the continuation to Staveley, to which point the time of 15½ min. from Sheffield—just over 12 miles distant—was the fastest of the series. But the climb to Heath did not come up to that of run 6, as it consumed 32 sec. longer, and involved a fall to 37 miles per hour on the 1 in 100, although even that was, of course, quite a good rate of ascent. After a slight permanent way check beyond Heath, the even 17 miles from Pilsley to Carrington were run in 17 min., less 1 sec., the speed on the falling grades being kept at about the mile-a-minute rate. Consequently, allowing for the delay, 4 min. were gained on the 50 min. booking of this train. Before leaving this table, it is interesting to notice the variation in the hill-climbing from Staveley to Heath. For example, No. 261 with 155 tons took 8 min. 50 sec., with 165 tons 8 min. 32 sec., and with 180 tons no less than 10 min. 5 sec.; No. 1093, of exactly the same type, required 9¼ min. with 180 tons,



Photo] [*W. H. C. Kelland.*

LONDON AND NORTH WESTERN RAILWAY.
Down Anglo-Scottish express, near Harrow.
4-4-0 superheater locomotive No. 1706 *Elkhound.*

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while No. 263, with 145 tons, completed the ascent in 8 min. !

Although excellent running was made by all the trains concerned between Nottingham and Leicester, time was only kept with difficulty owing to the increased loads. The most remarkable feature of the runs on this section was the smartness and uniformity of the starts from Nottingham. This is practically level until 2 miles beyond Ruddington, and on an ascending grade of 1 in 176 thence to East Leake. No train took over 6½ min. for the initial 4 miles 32 chains to Ruddington, or over 11½ min. (unchecked) to East Leake, which is a wonderfully smart time for a distance of just over 9 miles with loads up to 250 tons. Between the times to the first point there is no variation greater than 15 sec., and to the latter none more than 10 sec.—a fine exhibition of uniformity in running. After this No. 261 with the lightest load (run 7) drew away past Loughborough, although the hill-climbing of Nos. 262 and 1093 (runs 4 and 5) with substantially heavier trains was better from Loughborough to Rothley. The close correspondence of the two last-mentioned runs is very striking as far as Rothley, after which the much slower finish of No. 1093 gave No. 262 the lead by 15 sec. On most runs the speeds at Ruddington just reached the mile-a-minute rate, falling to about 51–53 miles per hour on the ascent past East Leake ; at Loughborough the speed averaged 69–71 miles per hour, while the drivers of Nos. 262 and 1093 both succeeded in maintaining a speed of all but 55 miles per hour up the ascent to Belgrave. The fast time of run 7 between Rothley and Leicester was due to its very smart finish, as a speed of 72 miles per hour was attained between Belgrave and Leicester.

We come now to the second, or continuation table, and find the Leicester–Woodford stretch as difficult for time-keeping with these loads as that from Nottingham to Leicester. No. 1088, driven by Johnson, made an excellent show. The sustained rate up Ashby Bank was 47·8 miles per hour, after which a maximum of 80·3 was touched before Rugby, and a further maximum of 75 before Braunston. No lower speed than 45 ensued on the long rise to Charwelton, and yet, with such good work, 10 sec. were dropped on schedule. Considering the very heavy load in run No. 2, No. 1093 really did well to drop only 80 sec. to Woodford. The maximum speed before Rugby was 78·9 miles per hour, and after 73·8, but the finest feature of this run was the minimum speed of 48·4 miles per hour at Charwelton. On run No. 3 No. 1093 did rather poorly—comparatively speaking !—as over 2 min. were lost on schedule without any delays. Its worst feature was the ascent of Ashby Bank, the time to Lutterworth being the longest of the series, but from that point the work was not bad, the time of 8 min. 5 sec. from Braunston to Charwelton in particular being quite good. The next run, behind No. 430, was an average "Director" effort ; the start was not so brisk as on No. 1 run, but

Photo] [*D. D. Hoblyn.*

MIDLAND RAILWAY.

Birmingham–Bournemouth express, passing Ashchurch.

4–4–0 locomotive No. 351.

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Photo] [*F. E. Mackay.*

LONDON & NORTH WESTERN RAILWAY.

A recent photograph of the 2.0 p.m. *ex* Euston on Camden bank, drawn by 4-6-0 four-cylinder superheater locomotive No. 2239 *Frederick Baynes.*

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the maxima before and after Rugby were the same, and with a faster ascent of Charwelton Bank the times tied at Woodford. Although over 2 min. were lost on schedule on run No. 5, this was really a very fine run, as the engine as far as Woodford was one of the earlier 4–4–0's—No. 112—without superheater. The start to Whetstone was commendably smart, but the rate fell to 40·5 miles per hour on Ashby Bank, and no higher maximum than 69·2 miles per hour was reached either before or after Rugby. An astonishing ascent of Charwelton Bank was made, however—by far the best, considering the type of engine, of the whole series—speed only falling to 49·5 miles per hour before we entered the tunnel, and 46·4 at the summit. This was a most creditable achievement.

Quite the best Leicester–Woodford run was No. 6. The start to Whetstone, on which we attained a maximum of 55·6 miles per hour, was magnificent, while the long 1 in 176 climb did not bring our speed below 50 miles per hour. Approaching Rugby we were doing 77·5 miles per hour, and near Braunston 75—both well sustained—while on the Charwelton climb we entered the tunnel at 52·9 and left it at 47·4 miles per hour. Despite a slow stop, time was improved on to the extent of a full minute, the 34 miles having been covered in 37 min. No. 7 was also an excellent run, but with a lighter load. To Whetstone quite brilliant work was done—faster than on any other run—but the effort fell off somewhat beyond Ashby, as the times thence to Braunston were beaten on every run but the two slowest. A good climb to Charwelton followed, however, the lowest speed being 50 miles per hour, giving a net time of 37¾ min. for the journey. On this section the hill-climbing was very consistent, the four "Atlantics" taking from Braunston to Charwelton respectively 7 min. 42 sec. with 165 tons; 8 min. 5 sec. with 195 and 230 tons; and 8¼ min. with 250 tons. The small 4–4–0 took 7 min. 40 sec. with 220 tons, and the large 4–4–0's 7 min. 40 sec. with 215 tons, and 7 min. 55 sec. with 230 tons. The distance is one of 7 miles 3 chains, and practically the whole of this is on an adverse grade of 1 in 176, so that average speed of the ascents—all made in from 7 min. 40 sec. to 8¼ min.—works out at the splendid figure of 51·2 to 55·1 miles per hour.

Some smart work was seen on the short run from Woodford to Brackley. This undulates continuously at the ruling grade of 1 in 176, the two stations being on about the same level. Two of the "Directors" made the best journeys—11 min. 55 sec. each start-to-stop for a distance of over 9¾ miles with loads of 220 and 215 tons! For some unknown reason No. 430 took the longest time of all—13 min. 5 sec. The "Atlantics" did well, particularly No. 1093, which with 250 tons covered the distance in 12 min. 25 sec. No. 261, on run 7, also started in great style, passing Brackley in 11 min. 27 sec., of course at full speed.

We come finally to the run from Brackley to London, which has the greatest interest as well as showing the greatest variation of all the sections of the journey. Strange to say, on this length the "Atlantics" combined, both uphill and downhill, to beat the "Directors" to a "frazzle," as our American friends would have it. No. 1 log represents the finest up journey that I have ever timed on the London Extension. The start from Brackley is superb for speed exhibitions, the line falling steeply, with two short breaks, right to Grendon Junction; on this run we touched a maximum speed of 81·8 miles per hour before Calvert, and passed Grendon in "even time." From Aylesbury the hill-climbing was of the very first water. On the first six continuous miles at 1 in 117 the speed never went below 48·9 miles per hour; the sharp drop past Missenden raised it to 75, and we then went over the 3 miles' ascent to Amersham without the speed falling below the mile-a-minute rate. On the steep descent to Rickmansworth we touched 76·3 miles per hour, and judging from the adjacent times we passed that station at a somewhat higher speed than usual. It is an astonishing thing that even to Rickmansworth, including the ascent to Amersham, the total time from Brackley start was only fractionally over "even"—42 min. 20 sec. for 42 miles 5 chains. Thence to London we ran in smartly, suffering a moderate permanent way check at Brondesbury, and thus completed the 59¼ miles' journey from Brackley in 62 min. 25 sec., or 62 min. net, no less than 5 min. inside schedule time. This was a run of which driver Johnson might very well feel proud.

No. 2 run was the only one on which time was lost, and, perhaps, reasonably so, as the load was really heavy for such a booking. The speed before Calvert was 77·5 miles per hour, and Aylesbury was passed in a minute under schedule, but a rather feeble climb to Amersham sufficed to lose this minute, while two more were unaccountably dropped

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between Rickmansworth and London. It was surprising to lose a minute between Harrow and Marylebone, seeing that every other driver contrived to gain from 30 sec. to a minute on this easily-timed length. Considering the increased load, No. 3 run was all but as good as No. 1. The start was equally smart, Grendon being passed in "even time"; the maximum rate before Calvert was 80·3 miles per hour. From Quainton Road to Amersham the times only differed by 30 sec., the speed of the heavier train on the principal ascent falling to 46·5 miles per hour. On the descent past Missenden, however, a higher rate of 76·3 miles per hour was touched, while at Amersham the speed fell just below the mile-a-minute rate. The difference between the runs in the speed through Rickmansworth, however, increased the "gap" from 30 sec. at Chorley Wood to 90 sec. at Northwood, and No. 1093 thus took 64 min. to complete the journey to London. But the difference in the actual running of the two trains was barely more than half-a-minute. So on the latter run also 3 min. were economised on booked time.

We now come to the three "Director" runs which, by comparison, were somewhat uninteresting affairs. It is also a curious fact that, excepting run No. 2, runs 1, 3, 4, 5 and 6 represent a succession of decelerations, the times on each successive run from Quainton Road southward falling behind those of the run immediately preceding it in chronological order. No. 430 touched a top speed of 77·5 miles per hour before Calvert, No. 431 one of 75, and No. 435 only 73·8. Further, while all the three drivers slackened most cautiously for both Grendon and Quainton Road Junctions, on run No. 6 we actually slacked to 40 miles per hour at both points. Again, the ascents to Amersham were most unenterprising, especially as each train was behind time; on the 1 in 117 No. 430 fell to a minimum rate of 40·5 miles per hour, and Nos. 431 and 435 actually to 39·1 miles per hour each! Despite this, each of the engines was inside schedule at Rickmansworth, and managed to complete the journey within booked time. No. 430 gained just over 2 min. from Brackley to London, No. 431 1¼ min., and No. 435 ½ min., in the latter two cases allowing for a very severe permanent way check at Rickmansworth. Although quite good, these three runs were disappointing in comparison with the splendid times afforded by the "Atlantics."

Photo] [*R. J. Purves.*

GREAT WESTERN RAILWAY.

Up "Cornish Riviera" express near Teignmouth.

4-6-0 locomotive No. 4027, *King Henry.*

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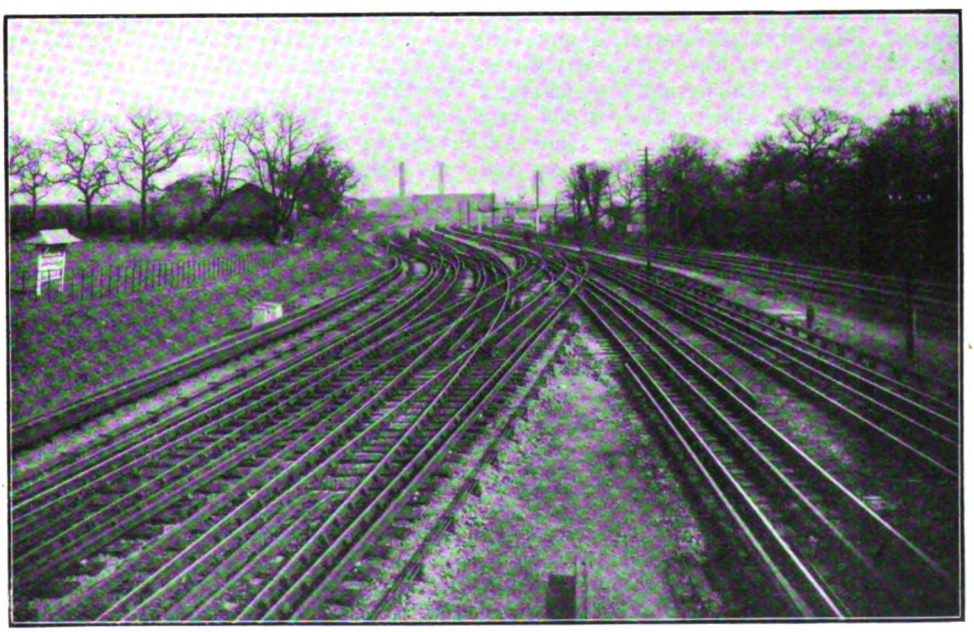
The last run was a very notable effort, the train, as previously mentioned, being much behind time. On the falling grades beyond Finmere the tremendous speed of 88 miles per hour was attained, and Grendon, 22¼ miles from the start, was passed in 21 min. 50 sec. The speed over the junctions at both Grendon and Quainton Road was evidently higher than usual, so that the time for the 31⅛ miles from Woodford to passing Aylesbury was only 30 min. 7 sec. On the ascent to Amersham, however, No. 261 did not do so well as either Nos. 1088 or 1902, with a lighter load, the speed falling to 45 miles per hour after Wendover. The time from Aylesbury to Amersham was 15 min. 43 sec., against 15¼ min. by No. 1088 with 30 tons more, and 15 min. 35 sec. by No. 1092 with 65 tons more—a nearly 40 per cent. heavier load. A maximum rate of 76·3 miles per hour was touched at Chalfont Road, but, unfortunately, adverse signals brought the train to a dead stand at Chorley Wood, the 49 miles 55 chains from Woodford, start-to-stop, having been covered in the amazing time of 50 min. exactly. The stop was only of 13 sec. duration, after which the 19⅜ miles to Marylebone were covered smartly in 23½ min., start-to-stop, including the slack at Rickmansworth, from which point 2½ min. were gained on schedule. Stop included, the gross time for the 69 miles 6 chains from Woodford to London was only 73½ min., but the net time could not have exceeded 71½ min., this exceedingly fine run reflecting great credit on driver Bell. I had other Great Central trips to describe, but considerations of space compel me to hold these over for another occasion. These few runs will serve to show, however, that in the realm of locomotive performance, whether uphill or downhill, the Great Central Railway need fear but few rivals.

COMPLICATED TRACK LAY-OUT ON AN ELECTRICALLY-EQUIPPED RAILWAY.



A FINE view showing a relatively complex lay-out of electrically equipped tracks is reproduced. It was taken by the Metropolitan Railway photographer, from the roof of the signal cabin at Wembley Park. To the left are the fast lines, with connections to the slow roads in the centre, and to the tracks leading to the railway works at Neasden. The chimneys of the power station can be seen in the distance. To the right are the Great Central steam lines. There are thus, beyond the junction and connection points, no fewer than six electrically equipped lines, and two steam lines.

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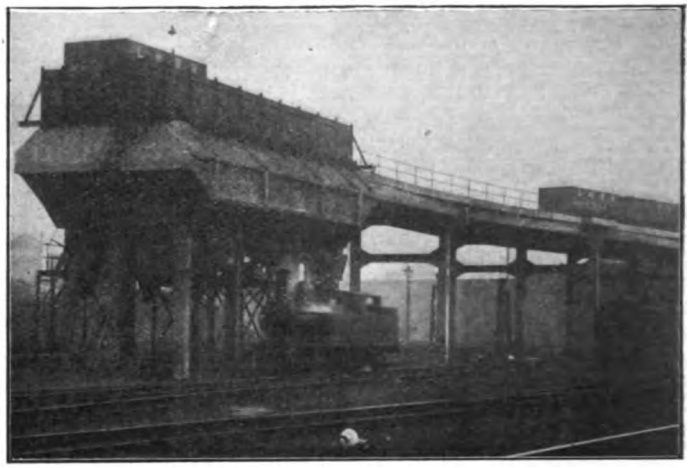
Engineering Developments on the London and North Western Railway.



GENERAL VIEW OF EDGE HILL COALING PLANT.

REFERENCE was made some time ago to the completion of a new coaling plant at Edge Hill Locomotive Depôt, and to the new loop line at Coventry, these being two of the most important undertakings which the Company has had in hand during the last two or three years; and some particulars of these interesting works will be of interest.

As the chief depôt in the busy Liverpool district, Edge Hill has control of some 140 engines, about forty-five of express classes, and thirty-five of tank design, the remainder being six and eight-coupled goods and mineral classes. Before the new plant was erected coaling was conducted on old methods, involving hand labour, so that with an average day's loading of about 300 tons a staff of fifteen or sixteen men, working in gangs, was required for this work alone. Moreover, as each engine had to remain at the coal stage for from 25–40 minutes, conditions did not favour expedition, while a blockage of the engine roads was by no means unusual. In addition, time spent at the coal stage could often have been more profitably utilised in the shed in carrying out small repairs and usual duties.

It was, therefore, decided to provide the up-to-date coaling plant to be described, and this has been in use for some time with considerable advantage. Now, an express engine can be supplied with 6½–7 tons of coal on its tender in a few minutes, 3¼–3½ being a record easily achieved, while in the case of engines taking smaller quantities there is a corresponding reduction in time occupied. The plant is supplied with three qualities of coal, a special quality as required for the tank engines working down to the Riverside station and through the streets of Liverpool along the quayside, good coal for the express locomotives; and an average quality for other engines.

On the coal plant the staff now used consists of six men working on two 12-hour shifts, and three youths as checkers, working one at a time in 8-hour shifts. Moreover, as the capacity of the plant is considerably in advance of immediate needs, many engines stationed elsewhere now take coal at Edge Hill before returning to the home depôt. This policy is also adopted with engines working to Crewe, where there is an elaborate coaling installation, with the result that these special plants are utilised to greater advantage than if they were limited to home engines, and still well below their capacity; while the fact that they are near the coalfields greatly reduces the cost, and a considerable haulage of locomotive coal is thus avoided.

At Crewe it was necessary to include in the coaling plant a "tippler" for wagons and conveyors for supplying the bunkers overhead. Edge Hill shed is, however, located within a maze of connecting and goods lines, several on a high level, so that a ferro-concrete structure was built out as a spur from one of the existing lines. Designs for this were prepared at Crewe, and the ironwork was made there, but the gantry and viaduct were put out to contract. During erection a special coaling bank was provided in the running shed, as the new plant is on the site occupied by the old coaling stage.

As the ordinary locomotive coal wagons are not adapted by bottom dumping, 150

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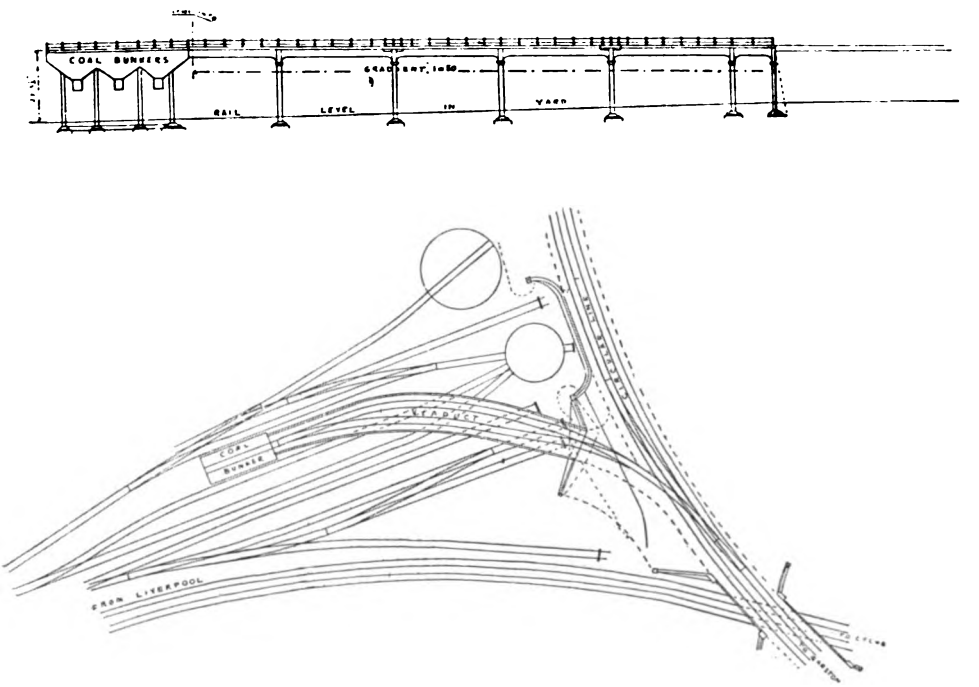
hopper-bottom wagons were specially built for serving the Edge Hill plant. These are brought by the overhead "circular" line with which connection is made, and run on to the spur. This has two lines, one for full wagons and the other for empties, and the wagons are hauled over the hoppers by means of capstans provided in convenient positions. As an ascending grade of 1 in 50 is involved to reach the hoppers, gravity is utilised for the removal of empty wagons. There are three hoppers respectively for the three qualities of coal required, and each will hold 40 tons, or 45 tons with careful trimming. Nine wagons are needed to supply the full loading of 120 tons.

Each hopper serves two shoots, one on either side, so that two engines can be coaled simultaneously from the same bunker if required. Coal is admitted first into the measuring shoot, and as the latter is moved into the coaling position, by means of a lever, communication with the bunker is closed, and access to the directing shoot opened. Each measuring shoot holds half-a-ton of coal. On one side of the stage these shoots are of ordinary construction. Each shoot has two levers, one to open the valve to release the coal, and the other to lower the shoot. It was found, however, that some classes of tank engines could not be conveniently coaled in this way, especially those with the bunker inside the cab sheets, and so the directing shoots on one side are specially constructed, so as to pass sufficiently far into the cab as to direct the coal well into the bunker. The additional directing shoot on the shunting engine side is loose, no separate operating lever being required.

Since this plant was brought into use it has entirely justified itself, and the whole work of the depôt benefits by the fact that engines are so quickly dealt with at the coaling plant, there is no congestion of waiting engines, and locomotives, after taking on coal, can go into the shed a very few minutes after arrival. We are indebted to Mr. C. J. Bowen Cooke, Chief Mechanical Engineer, for particulars of this interesting plant, and the courteous co-operation, on the occasion of our inspection, of Mr. J. W. Beaumont, Running Superintendent, and of Mr. L. Longbottom, who is in charge of the Edge Hill depôt, may also be acknowledged.



ELEVATION AND PLAN SHOWING LOCATION OF EDGE HILL COALING PLANT AND FERRO-CONCRETE GANTRY SERVING IT.

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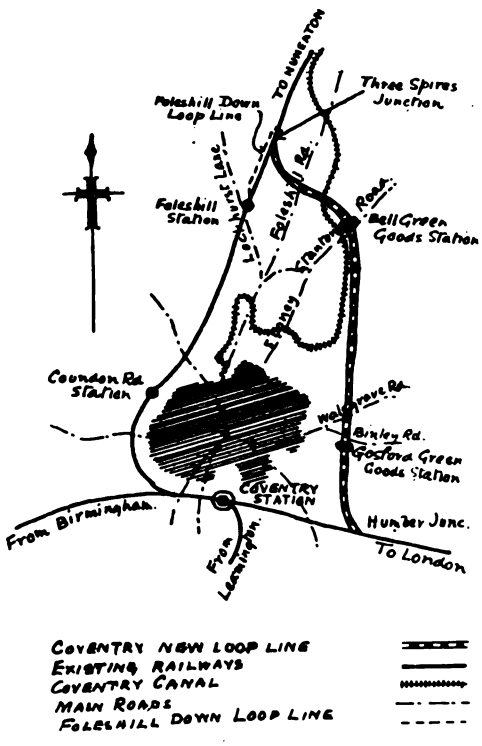

PLAN OF COVENTRY LOOP LINE.

Coventry may be considered as one of the "gateways" to the busy industrial areas of the South Midlands, and to the South Staffordshire coalfields, so that, besides the London-Birmingham and various local train services a large volume of mineral and industrial traffic passes through it. The station has, however, only limited capacity, and in order to relieve it of part of the industrial traffic passing through it powers were obtained in 1910 for the construction of a loop line connecting the Coventry-Nuneaton section with the Coventry-Rugby line east of the station, incidentally serving certain outlying portions of the town by new goods depôts adjacent to several large manufacturing establishments.

As projected, the line is a few yards over 3½ miles in length, leaving the Nuneaton-Coventry line at Three Spires Junction and joining the Rugby line at a new junction—Humber Road Junction—about a mile east of the passenger station, and close to the Humber Company's works. Construction commenced in August, 1911, the contractors being Messrs. Holme & King, of Liverpool. This firm, however, went into liquidation, and a new contract was made with Messrs. John Wilson & Son, of Birmingham, by whom the work has been finished, the London and North Western Railway taking over directly some of the sub-contracts made by the original contractors, such as those for steelwork for the bridges. On behalf of Mr. E. C. Trench, Chief Engineer, London and North Western Railway, Mr. Hull was Resident Engineer, and he saw most of the work completed in August, 1914, but as a Territorial officer he then joined the Forces, and Mr. G. F. Trench, who had been his assistant during an earlier stage of the work, was appointed Resident Engineer for the final stages.

Although virtually completed last August, the line has not yet been brought fully into use, and at one place recent wet weather has caused certain difficulties, the supports of an overhead footbridge having to be entirely rebuilt owing to the bank slipping. Otherwise, however, the line is virtually finished, and would have been brought into regular use earlier except for influences of the war. At present a few goods trains are worked over it, and in due course the line will be brought fully into use. For facilities for going over the line we are indebted to Mr. E. C. Trench, chief engineer, and other officers of the London and North Western Railway Company, while the co-operation of Mr. G. F. Trench, resident engineer, as guide may also be acknowledged.

As stated, the line is 3½ miles long, and skirts the town of Coventry, serving the Bell Green and Gosford Green districts by goods stations and yards erected at convenient places. The line includes several curves, the sharpest being of 25 and 20 chains radius, the former near Humber Road

ONE OF THE CONCRETE BRIDGES AS FINISHED.

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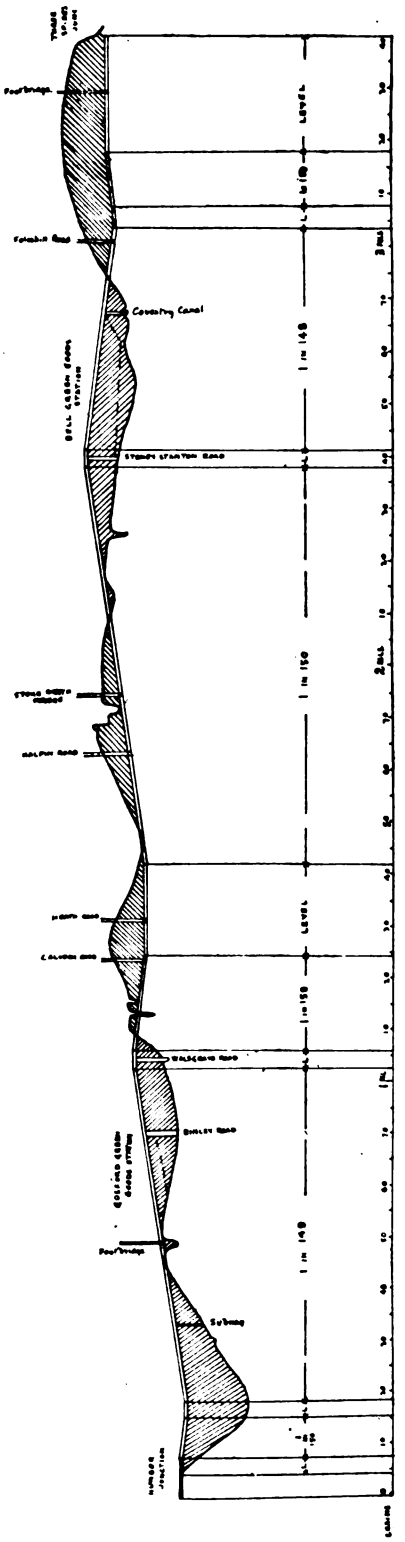

PROFILE OF COVENTRY LOOP LINE SHOWING LOCATION OF EMBANKMENTS, CUTTINGS AND BRIDGES.

Junction and the latter near Three Spires Junction, with compensated and transition curves to join older lines. About half of the line is on embankment, maximum height about 35 ft., and the remainder in cutting, greatest depth 31 ft. Some 377,000 cubic yards of excavation were involved, while about 396,000 cubic yards were required for embankments and road approaches. To provide the excess of material required for embankment, an additional area was cleared near Bell Green goods depôt, and this will probably prove useful at a later date. Altogether fourteen bridges had to be erected, including a 6 ft. subway, eight over the line and six under it, besides culverts, etc. Five of the overhead bridges are of ferro-concrete, arch form, the others being ordinary brick and girder bridges.

It will be convenient to follow the course of the line and detail its characteristics in order, commencing at Humber Road Junction. This is a new junction, with a signal cabin specially erected. The new line then sweeps round on a 25-chain curve, and is carried on embankment, broken only by a 6 ft. brick arch and skew subway to accommodate a footpath across the fields adjacent. About a quarter of a mile beyond is a 40 ft. span square girder bridge over a new road, and at this point connections are made to the yard of Gosford Green goods depôt. Here are four roads, with space for additional lines when required, a large warehouse, cattle pens, and usual offices, the yard being, however, substantially on surface level with descending approaches, whereas the line itself begins to rise past it on a gradient of 1 in 159. Near the signal cabin is a brick and girder footbridge over the line, connecting Humber Avenue with an old footpath.

Beyond Gosford Green goods yard is an under-line brick and girder bridge, built on the skew and 57 ft. 6 in. between abutments, crossing Binley Road, traversed by Coventry Corporation trams on the Stoke route. The new line having crossed one valley by the embankment extending from Humber Road Junction to the footbridge mentioned, is at this point crossing a second valley, extending past the next bridge, a 45 ft. span skew brick and girder bridge over Walsgrave Road. Here a new road was built as part of the works, extending Brighton Road, which runs parallel to the line and runs from Walsgrave Road to Caludon Road, where is the next bridge, thus compensating for the closure of part of Richmond Road, which crossed the

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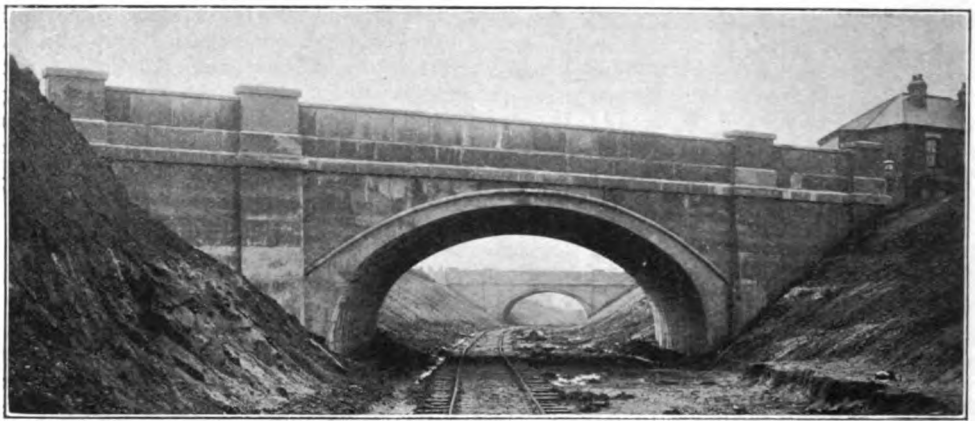

CONCRETE BRIDGE CARRYING HEATH ROAD OVER THE NEW LINE.
Caludon Road bridge is shown in the background.

site of the line. As the embankment between Binley Road and Walsgrave Road faces a public open space, Gosford Green, the slopes have been planted, by arrangement with the Coventry Corporation, with laurel bushes and other shrubs, and when these are fully grown the embankment will be quite picturesque. This has been done at one or two other places also.

A little way beyond Walsgrave Road Bridge the ground rises and the line passes into shallow cutting. Here are the five ferro-concrete bridges mentioned, these being of neat "arch" design, but possessing few features of special interest. The first carries Caludon Road over the railway, and is built on the skew, 40 ft. square between abutments. Next is a very similar bridge carrying Heath Road, and this also is on the skew. The third carries Burlington Road, a new thoroughfare, and is virtually square. The Company built a section of the new road, also a short spur therefrom, this being arranged in conjunction with the local authorities.

A little way beyond, the slopes of the cutting descend virtually to rail level, and then rise again to form the second cutting. The fourth concrete bridge—Halpin Road—replaces a private drive crossing the site of the railway. This is an ordinary square concrete arch. The final concrete bridge carries a public road to Stoke Heath, an area of common open to the public. As part of the contract, curved road approaches were built on either side of the bridge. A further section of embankment follows. Here is an underline brick and girder bridge carrying the railway over Stoney Stanton Road. This has a square span of 48 ft., but is built

UNDERLINE BRIDGE CARRYING THE NEW RAILWAY OVER BINLEY ROAD.

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slightly on the skew. On the west side of the line here is the Bell Green goods yard, located at a lower level than the railway, but on banked-up land. The warehouse and goods shed, with the offices pertaining thereto, are built on piers, and the yard has road access to the Stoney Stanton Road.

Beyond the goods depôt the line crosses over the Coventry Canal by means of a skew brick and girder bridge of 38 ft. square span. Here some difficulty was experienced in getting good foundations, but the work was not seriously hindered thereby. This bridge carries three lines of rail, the third being the shunting neck giving access to Bell Green yard. A short distance beyond this commences the chief cutting on the line. Crossing this is the Foleshill Road, the main road between Coventry and Nuneaton, and this is traversed by tramcars on the Foleshill and Bedworth route. The bridge is of brick and girder type, built on the skew with 26 ft. 6 in. square span. After being partially erected this bridge was widened an additional 8 ft. to provide an extra width of footway on one side. The original side girder was left in position, and the abutments on one side built out to carry a supplementary girder for receiving a transverse "Hy-Rib jack arch" built in concrete between the girders.

Where the cutting reaches its greatest depth a brick and girder footbridge of 66 ft. square span is erected, replacing a footpath crossing, and this is the work which has given greatest trouble. One of the supporting piers has had to be taken down entirely and rebuilt, owing to the slipping of the side of the cutting, the foundations being taken down to rail level. This is virtually the only part of the work yet unfinished. Just before the footbridge is reached commences the 20-chain curve leading to Three Spires Junction, where connection is made with the Nuneaton line.

The new loop is double track throughout and signalled as for a standard line, the two intermediate cabins serving Gosford Green and Bell Green goods depôts. As already stated, the only difficulties were the bridge over the canal and the foot bridge over the large cutting. Between Humber Road Junction and Binley Road it was found necessary to erect rubble stone tow walls at the foot of the embankment to provide against slipping.

Mention may also be made of the Foleshill down loop, though this is a different contract. For about three-quarters of a mile, extending from Foleshill station, on the Coventry–Nuneaton line, to beyond Three Spires Juuction, an additional down road is being put in. This has involved widening of the cutting, the demolition of a private road bridge, alteration of one of the side spans of a road across the line, and the construction of a new opening in Lythall's Lane Bridge, just beyond Three Spires Junction signal cabin. Otherwise the work is of an ordinary character. For this also Mr. G. F. Trench is resident engineer.

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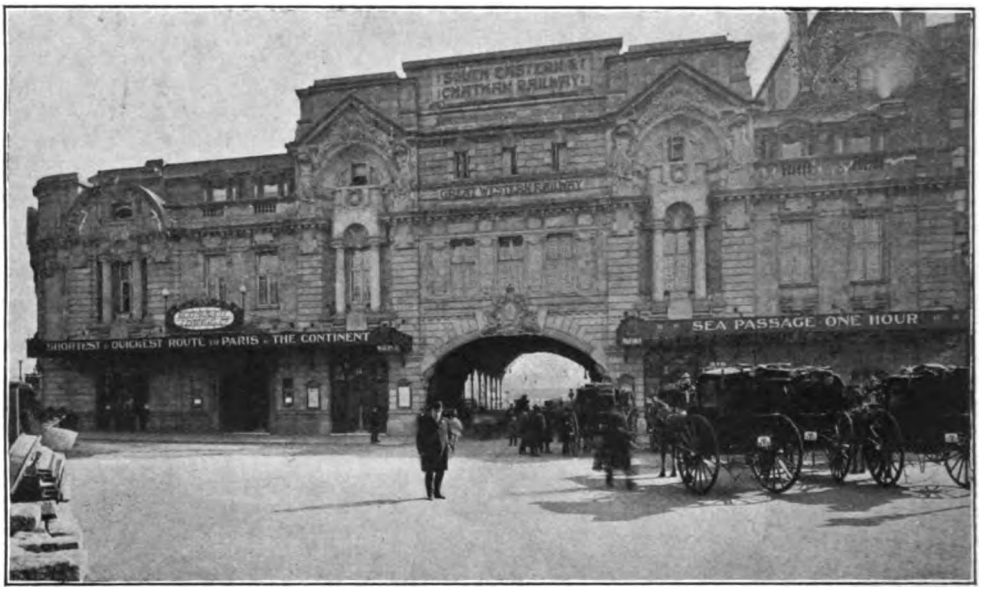

THE NEW FRONTAGE AT VICTORIA STATION, SOUTH EASTERN AND CHATHAM RAILWAY.

Railway Architectural Work.

By J. E. REID, Architect's Department, North Eastern Railway.

NO undertakings go in for so much building as do the railway companies, and it is quite a revelation to enter into the sphere of their operations and study their multitudinous activities and method of procedure. Even those who are interested in building operations can scarcely realise the innumerable erections required by the companies to accommodate their various requirements, apart from the stations that are so familiar to everyone. Besides the permanent way shops, wagon shops, engine stables, offices and buildings of all kinds that are congregated about the great termini in large numbers, elsewhere, wherever the lines ramify, through town, village, hill and dale, there are all kinds of structures built for special and definite purposes, besides thousands of houses and cottages for, and rented to, the servants of the company, whose occupations necessitate them residing near the permanent ways; there are houses for the station-masters, signalmen, porters, inspectors, etc.: for it must not be forgotten that in out-of-the-way places accommodation often has to be provided for them. They are usually up-to-date houses, having ample garden ground for the growing of flowers and vegetables, and rented to the station staff at a low figure.

There is one thing about railway building that cannot fail to engage the attention of the most casual observer, and this is its substantiality. The very nature of railway traffic necessitates this, and to build with a view to long life under heavy stress is imperative. Hence those materials that are of an enduring nature and will withstand the wear and tear for long periods are selected. At first this may cost more, yet in the end it is cheaper and insures against a large maintenance bill, which is the guiding principle in this case. Even the employees of a railway are also not too gentle either. The railway porter who pays scant respect to your travelling paraphernalia is the man who would damage the doors and frames of the parcels office if they were not cased with sheet iron up to station-barrow height; also the carter at the goods station would just as easily, with his cart, arris off the stone jambs and corners, if cast-iron burrs were not placed to drive him off. Likewise in many other positions iron is extensively used, when even the

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hardest woods would soon be severely damaged.

On the railway one meets with all styles of architecture, good, bad and passable; classic, gothic and hybrids from the types that have been handed down from the past. Sometimes one comes across some perfect gems in out-of-the-way places. It may be said that the architecture of the railway offers more of interest in its method of construction than its architecture, as art. In this respect, it seems only at the great termini that any attempts are made to embellish these gateways to a city. In the olden days the principal entrances to a city were overshadowed by bars, which were undoubtedly structures of architectural merit, as can be seen to-day at York and other ancient cities where they still exist in

AN EARLY RAILWAY GOODS WAREHOUSE, SHOWING OLD SYSTEM OF TIMBER ROOFING.

stately grandeur; but often the railway approach to a town is hidden, or rather mislaid, amid the labyrinthian gloom of some dark back street, and though it is at the station where a town greets its public guests and heroes, it seems to have no official recognition; it is neither a civic, government or national institution. It should also not be forgotten that the position of the station determines the town's arteries and lines of traffic and points of embarkation. The station is, in other words, the heart of the town, the source of vivid streams of energy. Yet it is often deplorable in its insignificance and not a model of architectural excellence, but instead, distinctly gloomy and dreary, a repository for soot and grimy advertising boards.

Architecturally considered, a railway station should be the key-note of a town, and like the bars and portcullis of old, be dignified and noble, and not such that it will mingle with its welcome a sickly apology. But at the same time, however feeble the architecture may be, how little of beauty a station may offer, they usually are models of building construction, and all students of architecture who are engaged upon their designing have excellent opportunities for acquiring insights into the essentials of strength, quality of materials, and methods of applying same; added to this, opportunities are offered for the exercise of ingenuity in planning and overcoming problems of all kinds.

The planning of a railway station has evolved along the lines of convenience and economy of working. These are the ceaseless agencies that mould it into shape and determine its subsequent alterations. If a railway company, by a re-arrangement of the administrative department, can save a few pounds in its annual wages bill, it will find it remunerative to carry out such alterations, obviously being a good investment. For instance, if one booking office can be made to do the work of two, by bringing them more into a central position, thus saving the cost of a few clerks, it would be done; or again, if one particular activity, say in the refreshment department, shows a healthy activity and desire to grow further, it will be given more prominence as against other activities that can be carried on in less prominent positions. This lies at the root of many alterations. The old railway stations as originally planned were very lavish with waste of important space, whereas to-day all space must pay a certain percentage towards the revenue. But improvements to

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AN EXAMPLE OF MODERN STATION ROOFING OVER COURTYARD.

a railway station are most often an indication of the town's increased prosperity, as no company readily lays out money on such, unless the returns call for it, however inconvenient the station may be. This should assuage a town's internal sores, that is to say, those towns that are ashamed of their railway stations. It is not to be supposed that the Directors are going to view any representative town's meeting in a favourable light otherwise. A railway company is a carrying concern and under these conditions is perfectly right—with a few exceptions—in being unable to meet the town's æsthetic or other tastes.

In structural work, the railway architect encroaches upon the sphere of the engineer. Iron and steel are extensively used and the methods of applying them differ very materially from fifty years ago, and as this material is superseding very largely stone and brick, many extensions to older buildings are carried out in that material. Hence one sees many incongruities in railway architecture. For instance, a good stone building possessing some architectural merit being extended in wood and iron; and again some years later, further extended in iron and corrugated sheeting. These periods, so to speak, are land-marks of the various influences at work affecting architecture. It is the principle of economic revolution and not of evolution of the beautiful. This is also the age of concrete. Of course concrete is no new thing, because the Romans used it very largely, but they contrived to hide it under a veneer of marble or stone. We use ours unblushingly and after inserting rods of steel, call it ferro- or reinforced concrete. Reinforced concrete implies the introduction of steel rods and bars intelligently distributed within a covering of concrete. These take up the strains, the whole forming a homogeneous monolith. There is a great saving in cost, space, and maintenance and resistance to fire. When we consider that steel will support thirty-five times more load than concrete, area for area, its economic advantage is obvious.

Railway companies are not backward in adopting this new method of construction. Since its introduction to the building world, many systems have been perfected, and also works written by specialists upon reinforced concrete, that aid an architect to a clear insight into its mysteries, and therefore it is imperative to architects, if they wish to keep abreast of the times, to become familiar with it, apart altogether from anyone's patent or specialized system.

ARTISTIC ARCHITECTURAL WORK AT WATERLOO, LONDON AND SOUTH WESTERN RAILWAY.

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Of course, there are one or two drawbacks against it. One is that no new openings can be cut into the fabric without disturbing the stresses and strains; another is that it is limited in its architectural treatment, because all mouldings and architectural ornaments have to be executed "in situ." It is therefore necessarily heavy and restrained as to its effects. Its methods are as yet in their infancy; time will furnish us with new data and methods.

Wood is another material that is largely used on the railway. It is light, and stations built of this material can be carried by piers over large spaces where the ground is uneven or irregular. It is workable into many beautiful designs, and its fading beauty can always be restored by a coat of paint. In some modern structures, wood works in very well with steel, with a light steel and glass roof over buildings and platforms. Wood also is not liable to easy fracture, and however much such a building may settle in the foundations, it can be jacked up level again without disturbing any interior structure or surfaces.

The presence of smoke inside of all stations, besides producing a gloomy effect, has the power of tarnishing all architectural work, and in those buildings where the ornaments and mouldings are very heavy, they form traps for the accumulation of soot. Hence gothic architecture is hardly a style that one would desire in a station until smoke ceases to be associated with locomotion. On those railways where electrical propulsion has been adopted, the absence of smoke and therefore dust is extremely pleasing, and the life of all surface coverings has been greatly extended.

Railway architectural work is usually given to outside builders who tender in the usual way. Very often special privileges are extended to them in the way of free passes over the line, which holds good until the termination of the contract; also special carrying facilities if the site is amid a number of lines, the access to which would be difficult.

The building operations being usually a considerable distance from the architect's office, the work is supervised by the architect through the agency of clerks-of-works who are responsible for the various contracts allotted to them, and hence the daily mileage of these men, as undertaken in the train, is by no means a limited amount. For instance, in some districts served by a few trains daily, the clerk-of-works may take nearly the whole day in reaching and returning from his destination, leaving him but a tithe of the time to inspect a work in progress. His life, one can imagine, is necessarily a very restless one, and patience not the least of his virtues. These gentlemen are specialists in their way, being drawn from the ranks of men who have themselves been engaged in practical work, representing, so to speak, the different operations of the building craft.

Railway companies do not come under the jurisdiction of a Local Authority. They enjoy this immunity together with His Majesty's buildings, canals and other companies under Parliamentary sanction. In reference to the railways, this immunity includes also all domestic habitations within the precincts of the stations. Thus extensive building can be carried out without the necessity of depositing any plans for the sanction of a local committee. From this it need not be inferred that they take advantage of such exemption as to build below the minimum prescribed by local bye-laws. Railway companies consider very seriously the health of their employees whose lives are passed between walls owned by them. But outside their boundaries or prescribed areas, railway companies are not exempt. This applies mostly when they acquire ground for the erecting of houses or business premises. In this case the intricacies of innumerable bye-laws and regulations have to be studied. Those whose work lies in fitting a plan to square therewith, heartily wish that there was some system of standardization throughout the country. It is the opinion of the writer that there are too many restrictions over non-essentials and not enough of essentials. Many bye-laws are hopelessly lop-sided; clothed as they often are in verbose language, their effectiveness is impaired by the omission of the very things that would prove their value as effective weapons in the hands of the local health authority. In many cases it is quite clear that, in their construction, the hand of the local builder has been at work so that his operations will not be too restricted.

Railway companies build houses by the thousand. They are called upon in many cases to make good the number of houses they pull down should their vast extensions include the demolishing of a number of streets. It might be said that they are rather unfairly dealt with in this respect. As such extensions imply the pulling down of slum property of little value, which has to be

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ROOF CONSTRUCTION AT SNOW HILL, BIRMINGHAM, GREAT WESTERN RAILWAY.

made good elsewhere with new houses and let at a nominal rent presumably to those tenants who have been evicted, it is one of those stipulations which add to the already heavy burden borne by the companies.

The cost of carrying out railway architectural work is, in many cases, much higher than under ordinary conditions. Reference especially is made to alterations to stations, when the contractor has to observe special conditions so that the business of the company or the convenience of the passengers must be interfered with as little as possible. This necessitates the erecting of barriers, lights, gangways and protections of all kinds during which certain sections of the work are carried on and brought to a certain stage, after which the barriers, etc., are removed and re-erected elsewhere to enable another section of the work to be proceeded with. This procedure is all planned out beforehand and the contractor is tied down to certain plans of procedure which form part of the contract in connection with the other plans. It sometimes taxes rather severely the mind of the architect in this category, because not only have the public to be protected, but the access to the various offices has to be maintained. Temporary booking accommodation has in many cases to be provided, also waiting rooms and conveniences of all kinds for the use of passengers. If the public knew how much they were considered during the carrying out of station alterations, less complaints over trifles would be heard from them. In the delivery of materials or removal of debris, the contractor is bound down to certain hours. If such operations have to be done by rail he will have to await the most convenient time when the business of the station is at the slackest. Night and Sunday work also engage the attention of the contractor when certain parts of the structure are in proximity to the running line. Here again he is limited to complete such work within a specified time. When the contractor's men are working near a running line, the contractor must provide special look-out men to warn the workmen of the approach of trains.

These stipulations which the contractor has to observe when carrying out his contract add to the cost of railway building. In estimating, therefore, for work of that nature the architect must take into consideration the exigencies of each case and allow for them.

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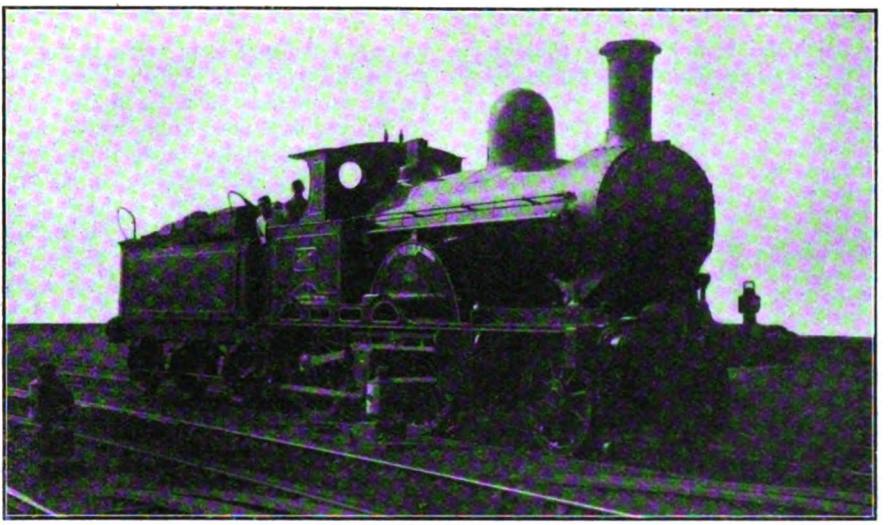

NO. 307 *Victor*. "EXPERIMENT" CLASS COMPOUND.

Locomotive and Train Working in the latter part of the 19th Century.

LONDON AND NORTH WESTERN RAILWAY. [No. IV.]

By E. L. AHRONS, M.I.Mech.E., M.Inst.Loco.Eng.

IN 1882 a new locomotive era began on the London and North Western Railway, for early in that year there appeared No. 66 *Experiment*, the first of Mr. Webb's three-cylinder compounds, and the work of this once celebrated type of engine is naturally connected with the main lines. Just at this period the "Bloomers" were rapidly disappearing from the Southern division, the "Lady of the Lake" class were much too light, and the main line work south of Crewe fell almost entirely upon the "Precedents." The "Experiment" compounds consisted of 30 engines built in 1883–4 (except the first of the class, which came out in 1882). They are too well-known to require very detailed description. The high pressure cylinders (outside) were 13 in. dia. by 24 in. stroke and drove the trailing wheels, and the single inside cylinder, 26 in. by 24 in., drove the middle pair of wheels. The *Experiment* itself had high-pressure cylinders only 11½ in. dia., but was subsequently altered. The driving wheels were 6 ft. 7½ in.* dia. and the pressure was only 150 lbs. A peculiar feature of these engines was the placing of the leading wheels very far forward. The boilers were the same as those of the "Precedents," with 1,083½ sq. ft. of heating surface, and the engines were evidently intended to do the same work. But they did not! Whilst giving the late Mr. Webb every credit for his ideas, and for the work which he undoubtedly did for the cause of compounding, it must be admitted that the "Experiments" at all events were partial failures. They generally had great difficulty in starting, the high-pressure engine would slip and choke the receiver without moving the locomotive, and if, as frequently happened, the ports of the low-pressure cylinder were not open, the engine would not start at all. At some stations men with pinchbars were employed to give the trains a start. The engines were employed on the Irish Mails and expresses both between Crewe and Euston and Crewe and Holyhead, trains which then were, as mentioned previously, expresses of a somewhat low grade.

The following is a characteristic run of engine 307 *Victor* of this class in 1885 on the

* Increased later to 6 ft. 9 in.

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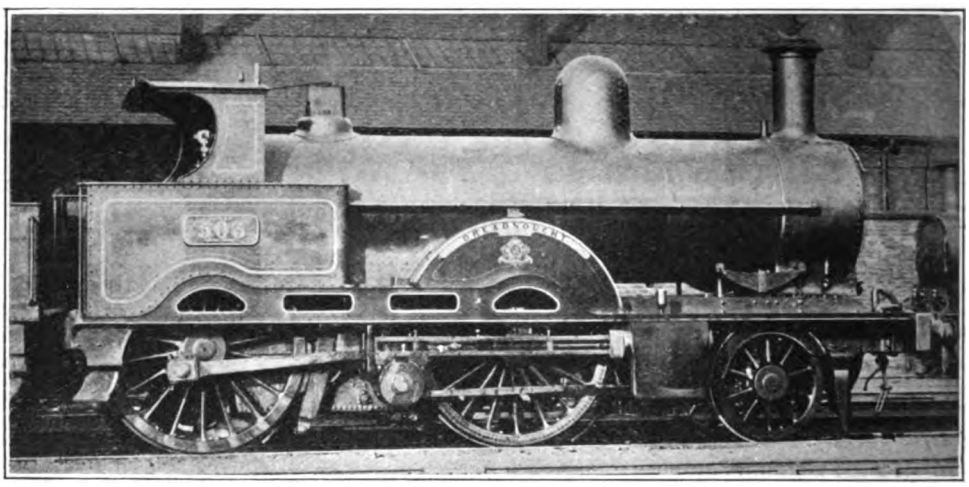
7.15 a.m. Irish Mail from Euston to Bletchley, with a load equal to nine 6-wheeled coaches.

Miles.				Speed.
—	Euston	dep.	7.17.0	—
5½	Willesden	pass	7.26.30	34·7
8	Sudbury	,,	7.29.55	43·9
11½	Harrow	,,	7.34.25	46·7
16	Bushey	,,	7.40.30	44·4
17½	Watford	,,	7.42.25	46·9
21	Kings Langley ..	,,	7.46.55	46·7
24½	Boxmoor	,,	7.52. 5	41·3
28	Berkhamsted ..	,,	7.56.45	45
31¾	Tring	,,	8. 1.40	45·8
36	Cheddington ..	,,	8. 6.35	51·9
40½	Leighton	,,	8.10.55	58·8
46¾	Bletchley	,,	8.18.40	53·2

The time allowed from Euston to Bletchley was 59 min., giving a running average of 47 miles per hour, and on this timing the compound dropped 2 min. 40 sec. with a light load of about 115 tons. Some years afterwards I travelled from Crewe to Stockport behind the same engine on the 1.28 p.m. from Crewe when she dropped 1 min. (taking 33 min. instead of 32 min.). *Lady of the Lake* with the same train and load gained nearly 2 min. Nor were they particularly economical in coal. I have before me some of the detailed Crewe coal sheets, 1885, from which I find that eight of the class in the "London link" averaged 33¼ lbs. of best Welsh coal per mile, and that 13 others in the "Holyhead" links burnt 31·4 lbs. per mile. Two engines 363 *Aurania*, and 365 *America*, averaged 37 6 lbs. per mile at Rugby shed. Comparisons between engines of different railways are not always scientifically accurate, owing to the different conditions prevailing, but there were never in my opinion any valid traffic or gradient reasons why these compounds should require from 4 to 10 lbs. per mile more than other companies' engines doing similar work. The "Experiment" compounds retired from the London road as heavier engines took their places, and their usual "beat" was afterwards between Crewe and Holyhead and Crewe and Manchester, where the trains were light and gradients easy. As soon as Mr. Whale succeeded Mr. Webb he scrapped the lot.

The "Dreadnoughts" were the next to appear at the end of 1884 and, to do them justice, they did a great deal of hard main line work, as far as mileage was concerned, for with Mr. Webb at the head of affairs, they simply had to, whilst many of those who had the practical handling of them, seethed inwardly during such periods as had not to be devoted to official enthusiasm.



2-2, 2-0 COMPOUND NO. 503, *Dreadnought.*

The "Dreadnoughts" were much the most powerful express engines that the London and North Western Railway had had up to that time, and for that reason their performances have to stand by themselves, as they could not properly be compared with the much less powerful engines that preceded them. The pressure was increased to 175 lbs., and the boiler had 1,242 sq. ft. of tube surface and 159 sq. ft. of firebox surface—a total heating surface of 1,401 sq. ft. But the firebox heating surface was somewhat misleading, because these engines had a water grate, the heating surface of which was included in the total. Now heating surface

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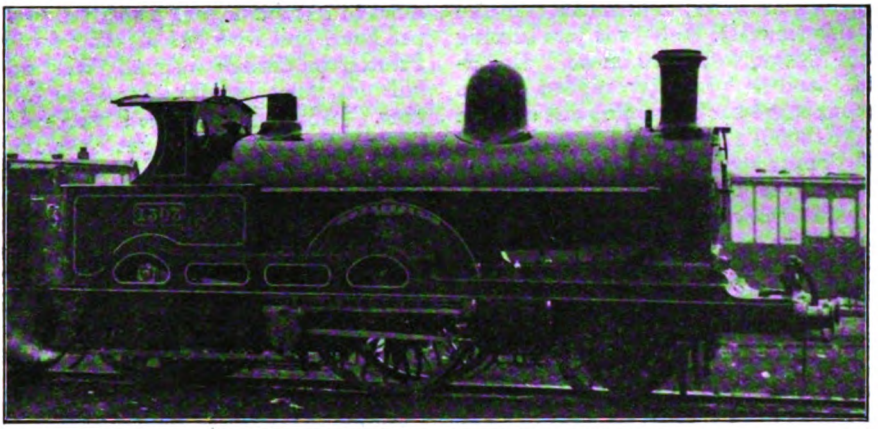
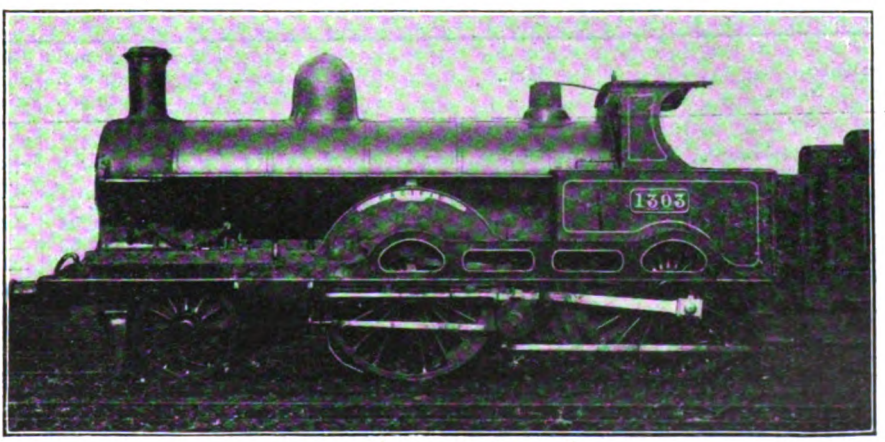


NO. 1303 *Pacific.* With original extended front.

under the fire is of hardly any value, so that the firebox surface ought to be reduced to 139 sq. ft. instead of 159 sq. ft. Nevertheless the boiler was the best as regards steaming qualities that Crewe had so far produced. The cylinders of the "Dreadnoughts" were high pressure 14 in. by 24 in. outside, and low pressure (one) inside 30 in. by 24 in. The driving wheels were only 6 ft. 3 in. dia.

These engines had the same faults as the previous "Experiments," but in a less degree. The starting, though at times defective and troublesome, was generally better owing to the smaller driving wheels, larger high pressure cylinders, and increased pressure, all of which factors enabled the engine to move slightly and thus enable the low pressure cylinder to begin to do some work. A fore and aft surging motion could be felt throughout the train at the start, and was very pronounced in the front coaches, but died away as the train gathered speed. The most marked defect was the absence of coupling rods. This want of coupling rods caused a lack of synchronism between the high pressure and low pressure engines, and as one could slip when the other did not, the receiver could get choked with steam if the high pressure engine slipped, or denuded of it when the low pressure engine did so.

Mr. Webb had occasionally to stand some hard knocks over these engines, of which, perhaps, the hardest were from an engineer of high standing, who, under the *nom-de-plume* of "Argus," "went for" Mr. Webb and his compounds "tooth and nail" in the columns of *Engineering*, and finished up a terrific onslaught by referring to the late chief of Crewe as a neophyte who, having seen a compound engine at an exhibition,



NO. 1303 *Pacific.*
Three-cylinder compound, "Teutonic" class, with shortened front.

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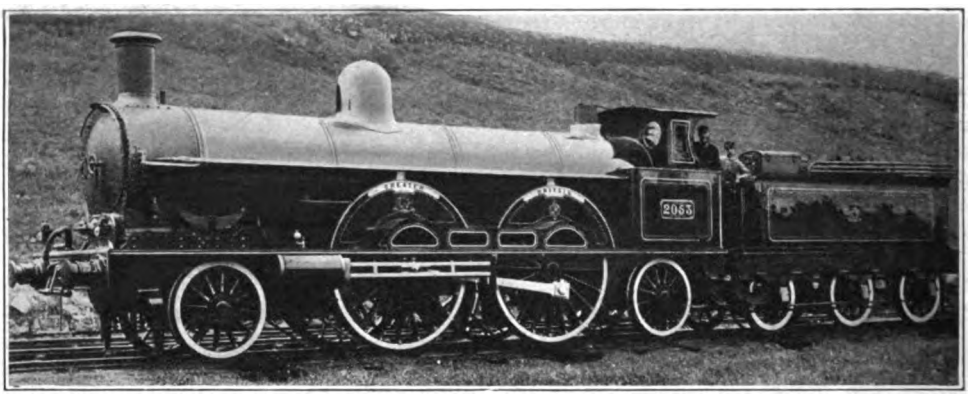
proceeded home to try and make one like it. At this time Mr. Webb was just turning out from Crewe works 20 more "Dreadnoughts," and he promptly replied to his anonymous aggressor by naming one of them *Argus* (No. 2056) after him.

The "Dreadnoughts," of which there were 40, (the last ten came out in 1888), did 15 years' hard work between London and Carlisle. Most of them were stationed at Crewe—they could be nursed better when at headquarters—but in 1888 London had a few of them. They were curiously uncertain engines in their performances. Occasionally they would put up a good fight, but more frequently they were mediocre, and sometimes very bad. Taking a sample of runs between London, Bletchley and Northampton, the following are from one of my notebooks:



Photo] [*Loco. Publishing Co., Ltd.*

2-2, 2-2 COMPOUND NO. 2053, *Greater Britain*.

No.	Engine Name.	Run.	Miles.	Load. tons.	Booked Speed. m.p.h.	Actual Speed. m.p.h.	Time gained + or lost —
							M. S.
173	*City of Manchester* ..	Willesden to Northampton (bad signal check Bletchley)	60⅜	110	50· 3	51· 6	+1 47
2064	*Autocrat*	Northampton to Bletchley ..	19¼	190	44·45	42·45	—1 13
2058	*Medusa*	Bletchley to Willesden ..	41⅛	135	48·38	50·25	+1 53
1370	*City of Glasgow* ..	Blisworth to Bletchley ..	16⅛	135	46·06	43·33	—1 20
1370	*City of Glasgow* ..	Bletchley to Willesden ..	41⅛	135	48·38	48·22	— 10
1353	*City of Edinburgh* ..	Northampton to Willesden ..	60⅜	100	51·74	49·56	—3 5

It is fair, however, to say that they sometimes gave much better results than the above. Mr. Rous Marten recorded a run with No. 643 *Raven* from Willesden to Rugby in 85 min. 20 sec. (with one signal check) and a load of 190 tons, and Rugby to Crewe 75½ miles in 78 min. 56 sec., a speed of 57·4 miles per hour, and with 511 *Achilles* a run from Preston to Carlisle over the Westmoreland hills 90 miles in 100 min. 3 sec. with 180 tons. After Mr. Whale's succession the "Dreadnoughts" were put to branch line work and many of them went to Shrewsbury. I also used to see 173 *City of Manchester* on the Northampton to Nottingham service with trains of four or five 6-wheeled coaches. After this they all went to Crewe to be scrapped after only 16 to 20 years' work. As coal consumers they were distinctly on the heavy side, and averaged 35 to 38 lbs. per mile.

There was one black sheep amongst the "Dreadnoughts," the last of the first batch of ten, No. 685 *Himalaya*. A leading engineer who was at Crewe when she was new told me at the time that she was not truly built, *i.e.*, was not "square." Anyway, she was always in trouble, and was banished to Shrewsbury in her early days, to work trains between there and Hereford. Shrewsbury frequently had to help Crewe out of compound difficulties by taking charge of "lame

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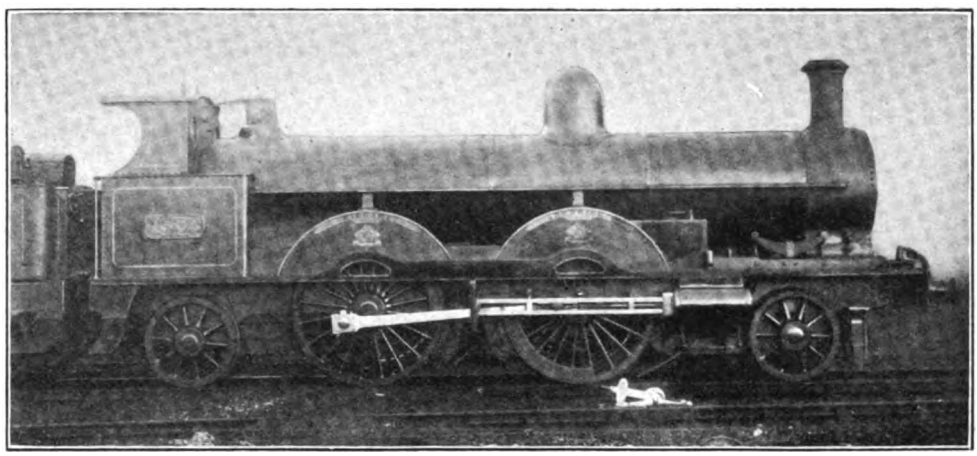
ducks." In their latter days Shrewsbury was simply bombarded with compounds, and became in effect a sort of "marine stores" for them.

I must now make a return to the celebrated "Precedents," of which in 1882 there were 70. Whenever any steady, reliable work had to be done, the London and North Western locomotive department fell back upon these somewhat under-sized engines, and it must be admitted that the little engines generally "popped up smiling" and did it.

The last two of the 1875 to 1882 batch were 364 *Henry Pease* and 955 *Charles Dickens*, both of which were at Longsight. The laurels of fame went to *Charles Dickens*, for *Henry Pease* seems to have played a very



NO. 1505 *Richard Arkwright*
"John Hick" class, three-cylinder compound (1898).

secondary rôle throughout its existence, generally between Manchester and Crewe. It still survives at Longsight. I am, however, specially concerned now with the more famous engine of the two. According to the official records *Charles Dickens* ran one million miles in 9 years 219 days, and completed 2 million miles on August 5th, 1902, and finished its career in November, 1912, when it was broken up after more than 30 years' work. *Charles Dickens* always worked the early morning (8.30 a.m.) express from Manchester to London *viâ* Stoke, and returned with the 4 p.m. from Euston. Now one hardly likes to throw any doubts upon the details of the strenuous life of this great little engine, but I should really like to know how much of the original engine was left at the end of its career, beyond the name and number plates. Was *Charles Dickens* like the sailor's knife with three or four new blades and a similar number of new handles? Nearly all the other "Precedents," including its sister engine the *Henry Pease*, which ran a mileage much less than the *Charles Dickens*, were completely renewed between 1894 and 1898, so that they became new engines with new motion and new Crewe works numbers. Of course, I may be mistaken, and there may have been some bits that travelled the whole of the two million odd miles. My first record with 955 was in 1886, when she ran from Blisworth to Willesden, 57¼ miles in 66 min. 50 sec.—the booked time being 66 min. The maximum speed at the 22nd and 7th mile-posts being 62·1 miles per hour, but I forgot on this occasion to record the load when copying the rough notes. My last through trip from Manchester to London with No. 955 on the 8.30 a.m. from Manchester was in 1899. The load was equal to 15 coaches from Stockport to Stoke (about 190 to 195 tons), 9 from Stoke to Rugby, and 13 from Rugby to Willesden. *Charles Dickens* on this occasion—as always—had a pilot, a D.X. goods engine, from Stockport to Congleton, and time was lost at Atherstone level crossing, this being during the time of the celebrated feud between the London and North Western Railway and the local authorities at Atherstone, when the latter got an injunction against the railway and made them slow all express trains down to 4 miles per hour over the Watling Street crossing. We left Rugby 7½ min. late, took 27 min. to Blisworth (19¾

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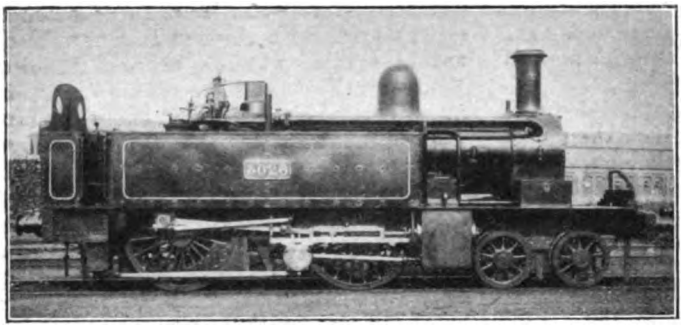


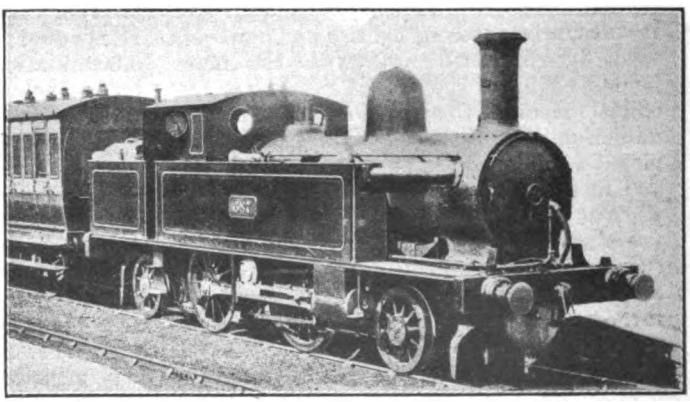
NO. 2063. The first compound tank engine (1884) converted from a Metropolitan type engine.

miles) where we stopped 1 min., then 21½ min. for the run from Blisworth to Bletchley (16⅛ miles) and leaving Bletchley 10 min. late lost 1½ min. to Willesden, where we arrived at 12.54½ instead of 12.43, having taken 52½ min. for the 41⅛ miles. It was not an inspiring performance, and my special recollection of it was accentuated by the way in which *Charles Dickens* was being "thumped." I was in the second coach from the front and we travelled to the continuous accompaniment of a shower of hard hitting cinders on the roof of the carriage.

In 1887 Mr. Webb began the "conversion" of all the 96 Ramsbottom's 6 ft. 6 in. coupled to "Precedents," and completed the last of them early in 1894. I use the term "conversion"; the old engines were not rebuilt in any sense of the word as usually applied in locomotive matters. The old Ramsbottoms, with their frames and Stephenson link motions, were completely broken up, and the Phœnix-like "Precedents" that rose from the débris had nothing in them of the old engines except the name plates.

The principal difference between these new "Precedents" and the earlier 70 engines was an increase in the boiler pressure from 140 lbs. to 150 lbs., but some years afterwards the earlier engines were similarly altered, and, moreover, the whole of the 166 engines of the class were supplied with thicker tyres so that the diameter of the coupled wheels became 6 ft. 9 in. I emphasize this point because they have always been referred to as 6 ft. 6 in. coupled, and my friend, the late Mr. Rous Marten, when he recorded speeds of 87 and 88 miles per hour with these engines, referred to these speeds as having been performed with engines having 6 ft 6 in. wheels. This difference is of some importance. The error is usually overlooked, because all the "Newton" class and the "Precedents" were always officially referred to as 6 ft. 6 in. coupled.

The new engines were not long in showing what they could do. During the Scotch racing days of August, 1888, one of them *Vulcan* 275, ran from Preston to Carlisle, 90 miles, over Shap summit in 90 min. But the load was very light—4 coaches, weighing 80 tons. In the 1895 race, No. 790 *Hardwicke*, over the same road, eclipsed all previous records (on the 8 p.m. from Euston) by running from Crewe to Carlisle, 141¼ miles, at an average speed of 67·2 miles per hour throughout. My own experiences over the main lines between Euston, Carlisle and Holyhead were generally good, and with a few exceptions the engines did all they were required to do. More than this could not be expected, but I was never fortunate enough to record any of the brilliant performances



NO. 687. COMPOUND TANK ENGINE.
(The "Fore and Aft.")

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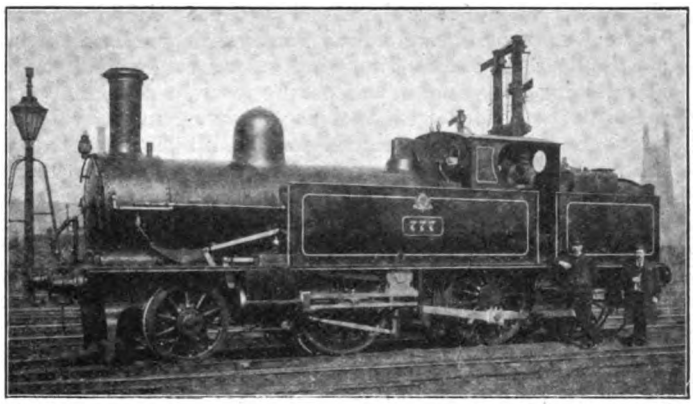
which they undoubtedly accomplished at times, and for this reason I find nothing amongst my notes that merits special mention. There are plenty of runs averaging 50 to 52½ miles per hour, and a maximum of 72 miles per hour down the Grayrigg bank with two engines.

I trust I may be forgiven for pointing out what I have always considered the one fault of these otherwise splendid little engines, and this fault was that they *were* such little engines. They were splendid runners, and frequently gave phenomenal speeds, but with anything above an average load they had to be flogged. I have already referred to the *Charles Dickens* throwing a shower of cinders out the whole way from Rugby to Willesden. If you have a small boiler, and a small grate, to do heavy work, a small blast pipe is a necessary accompaniment, and the combination of small blast pipe and small grate means the throwing of a quantity of unburnt fuel out of the chimney. The fact is that the "Precedents" for this reason always were heavy coal burners, and I have before me a record of the consumption of 14 of them at Rugby that averaged 42½ lbs. of coal per mile, and 13 engines at Crewe that burnt 36½ lbs. per mile. This was before 1890, when loads and speeds were not as high as they were afterwards. Moreover, this was Welsh coal, which does not burn so rapidly as Yorkshire or Derbyshire coal, and at that period 30 lbs. per mile was considered a fairly high rate of fuel consumption.

Between 1889 and 1895 the feeble 16 in. "Samsons" were broken up, and the "Whitworths" having the same names and numbers came out. These, with their 6 ft. 3 in. wheels and 17 in. by 24 in. cylinders, were in reality "Precedents" with smaller wheels. I have mentioned before that there was nothing of the rebuild about them. The scrapping of the old "Newtons" and "Samsons" involved a change in the locomotive working all round. The places of the "Samsons" on the branch line trains were taken by the 5 ft. 6 in. 2–4–2 side tanks of the 910 class.

The "Whitworths" went on to the Leeds road in place of the "Ramsbottoms" and old "Precursors," and also worked a number of main line trains. The first of them in 1890 were stationed at Preston. They have always done very good work, and I have recorded speeds of 70 miles per hour with them. It seems a pity that both they and the "Precedents" are being broken up so rapidly, for they would seem to be ideal engines for the longer branch lines, of which the London and North Western Railway has a considerable mileage.



Photo] *[Loco. Publishing Co., Ltd.*

COMPOUND TANK ENGINE NO. 777 (2-2, 4-0 TYPE)
Shown at the Manchester Exhibition, 1887.

The inner history of the continuous brakes question on the London and North Western Railway would, if it could be written, provide interesting reading. Firstly, there was the Clark and Webb chain brake, which in 1878-9 was upheld by the then Chairman of the company as the most perfect appliance that could be devised. But it could only be used on short trains or sections of trains. One end of the chain was secured to the end of the furthest carriage, and the other to a revolving shaft on the brake van. A friction drum on this shaft was wound up and levers on the carriages were raised and the brake applied. Sometimes it did not work, and then something happened, such as occurred to a train near Winsford that travelled about a mile too far and dropped into the gap made by some platelayers who had just removed a length of rail. When the automatic vacuum became established on the London and North Western Railway the brake blocks were kept off the wheels by a small ejector, which had a steam outlet at one of the front corners of the top of the cab. For some time we enjoyed the spectacle of every London and North Western Railway passenger engine showing an artistic-looking jet of steam like a long white feather issuing from

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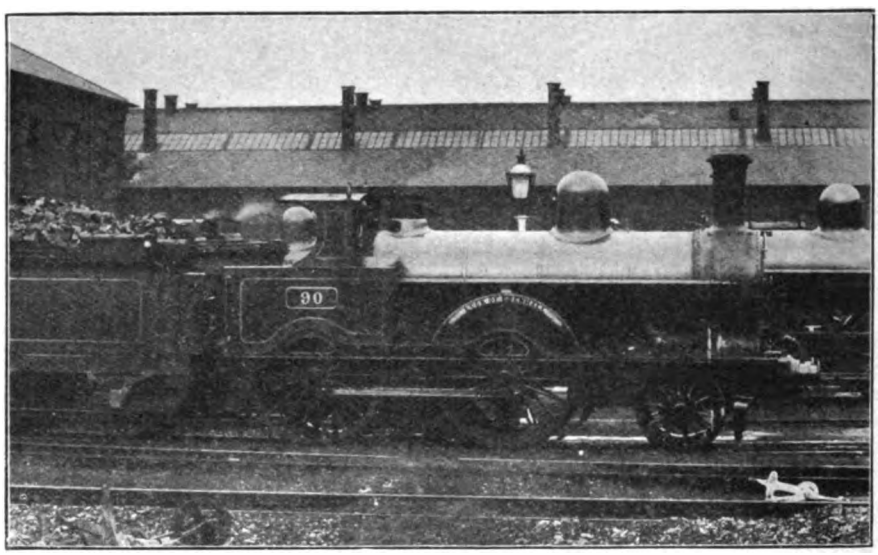
the cab. Then Crewe borrowed a Great Western drawing of a crosshead pump, such as the latter line had used for some years for maintaining the vacuum, and having got it, promptly proceeded with various improvements, one of which was increasing the lift of the disc valves. The disc valves promptly hammered themselves to bits in record time. I hope I am not treading upon any tender corns; I hasten to add that I am writing of the Crewe of 25 years ago, and it is ancient history now. However, so much for brakes!

Before mentioning the later three-cylinder compounds, a few words may be written of the four compound tanks. The first was a rebuild in 1884 of one of Beyer Peacock's Metropolitan type side tanks (No. 2063). The second was 687, a 2-double 2–2 arrangement built in 1885. Had the London and North Western tank engines had names like the tender engines, I would have respectfully suggested the name "Fore and Aft" for 687. I have already mentioned the peculiar surging motion in connection with the 'Dreadnoughts" when starting. This was occasionally unpleasant, but did not last long enough, as it died away as the speed increased. Now the "Fore and Aft" had it much worse than the "Dreadnoughts"; and as this engine was for a time on the District line (Willesden and Mansion House), and consequently was continually starting, the result can be better imagined than described. I had some experiences of it myself—on one occasion when leaving Victoria (Underground), a carriage full of passengers were swinging backwards and forwards after the manner of a University "eight." I am afraid that the "Fore and Aft" was the cause of much bad language.

Of the other two tank engines, very little can be said. 600, built in 1887, was a larger edition of 687, and was employed in the Manchester district. No. 777 was shown at Manchester Exhibition in 1887, and when I saw it there was numbered 2974. It was described as a compound *goods* tank engine, and was "consequently" put to work passenger trains! It put in a few years' work on the Manchester and Buxton service. I never had any personal experiences with either 600 or 777*, so am not in a position to say anything about them. But they all must have had shortcomings, for even Mr. Webb, in spite of his enthusiasm for compounds, never constructed any more than the four tank engines mentioned.



NO. 90, *Luck of Edenhall.*
"Whitworth" class, 1889-1894, 6 ft. 3 in. wheels, 17 in. by 24 in. cylinders.

The first three of the 7 ft. three-cylinder compounds—the "Teutonics"—came out in 1889, and were followed in 1890 by seven more. The cylinders of *Teutonic* and the

*No. 600 had 5 ft. 6 in. driving wheels, and cylinders h.p. 14 in., l.p. 26 in. by 24 in. stroke. No. 777 had 5 ft. 2½ in. driving wheels with cylinders, h.p. 14 in., l.p. 30 in. by 24 in. stroke.

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seven last engines were as in the "Dreadnoughts," 14 in. dia. for the two high pressure, 30 in. dia. for the single low pressure, by 24 in. stroke for both, but when first constructed the *Oceanic* 1302 had 28 in. low pressure cylinders, and the *Pacific* 1303 had 20 in. ditto. These were for experimental purposes, and they were subsequently altered to "Teutonics." Moreover, the low pressure pistons of all the ten had tail rods at the front, which necessitated the buffer beam being fixed about 18 in. further forward than in the "Dreadnoughts." There must have been some difficulty with the overhanging weight, for some time later the tail rods were suppressed and the buffer beams brought in, but it was always stated by those who knew, that the "Teutonics" were better engines before the abolition of no proper "guiding influence" on the main frame of the engine in front of the driving wheel flanges. This is clear if one considers that the radial axle can swing about from side to side under the engine at the front end.

But the "Teutonics" from the compound point of view were head and shoulders above the remainder of Mr. Webb's compounds, and did much the finest work. I consider that the 7 ft. wheels were responsible for this, as the high presusre and the low pressure engines could work much better in unison, than they could with the smaller 6 ft. 3 in. wheels, and "imperceptible slipping" to which all locomotives are subject, would not produce such a bad effect.

The performances of these engines are so comparatively recent that I do not intend to take up much space by repeating them.

Photo] [*Loco. Publishing Co.*

NO 1211 *John Ramsbottom.* (ONE OF THE LATER "PRECEDENT" CLASS RENEWALS.)

the tail rods than they were afterwards. The 7 ft. driving wheels were stated at the time to have been taken from 20 of the old "Bloomers," the wheels of which, having been found to be in excellent condition, were preserved at Crewe. Here is a conundrum for those who talk loosely about "rebuilds," for if the 1887 to 1894 "Precedents" were rebuilds of the earlier 6 ft. 6 in. "Ramsbottoms," then the "Teutonics" must have been rebuilds of the "Bloomers"! And I hardly think there is anyone who would make this last statement. Like the "Dreadnoughts," they had Webb's radial leading axles, a somewhat dangerous design for an express engine, for unless the check springs are so exceedingly stiff as to convert the radial axle almost into a rigid one, there is

Jeanie Deans 1304 worked the 2 p.m. Scotch dining train daily from January, 1891, until August, 1899—with trains weighing 260 to 310 tons, and almost always kept time. *Ionic* 1306 ran from Euston to Carlisle (299¼ miles) without a stop in 1895 at 51 miles per hour, and also was one of two engines which ran from Crewe to Carlisle (141¼ miles) in 143 min. Finally, *Adriatic* 1309 made the record run between Euston and Crewe during the Scotch racing of 1895 by covering the 158 miles in 148 min. *Jeanie Deans* was stationed at Camden; I believe all the others were at Crewe, though I am not sure whether one at least was not at Rugby.

The "Greater Britains" and "John Hicks" were of a somewhat later date, and I was

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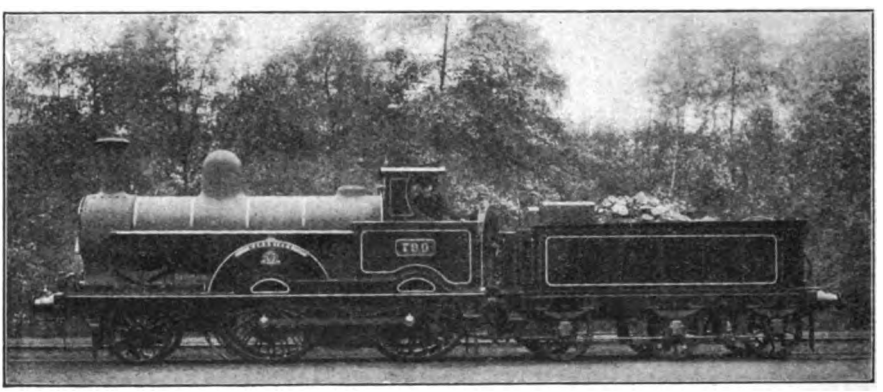
abroad during a great part of the time that the "Greater Britains" were doing their best work. I had one or two moderately fair runs with them afterwards, the best being Rugby to Crewe (75½ miles) in 87 min.—52½ miles per hour—with 2052 *Prince George* and 145 tons. As the engine gained 2 min. on the booked time, there is no further comment to make.

Mr. Whale absolutely slaughtered the three-cylinder compounds after taking charge at Crewe. I was glad to see the "Experiments" go, and did not much mind when the "Dreadnoughts" went, or even the "Greater Britains," but I must confess to being genuinely sorry when the "Teutonics" were scrapped. As for the subsequent "John Hicks," the less said about them the better. They had the same sized wheels, 6 ft. 3 in., as the "Dreadnoughts," all the faults of the latter, but none of their virtues. They were employed principally between Crewe and Carlisle.



NO. 790, *Hardwicke*, ONE OF THE LATER "PRECEDENTS," BUILT 1892, AND A FAMOUS ENGINE INDIVIDUALLY.

An old acquaintance writes that the 7 ft. "Bloomers," *Duke* and *Ariel*, were stationed at Camden, whilst *Trentham* and *Stork* were at Rugby. The "extra large" 7 ft. 6 in. "Bloomers" frequently ran the 5 p.m. down trains from Euston on Sundays, sometimes with a 7 ft. "Bloomer" as pilot. Later *Caithness* and *Maberley* seem to have been transferred from Camden to Rugby.

Of the small "Bloomers" engines *Langdale*, *Swan*, *Swift* and *Mammoth* were at Rugby in 1879. *Bela* had been removed from Stafford to Bletchley. *St. David* and *Cadmus* were then at Northampton. Of the Trevithick singles at the same period, 367 was at Northampton, and 927 and 928 at Rugby.

"E. L." also writes as follows: "I have been much interested in reading Mr. E. L. Ahrons' articles, particularly that portion which deals with the last few years in which the London and North Western Railway 'Lady of the Lake' single-wheel engines were running. Between the spring of 1903 and the autumn of 1906 I travelled a good deal in the Oxford and Bletchley districts and had thus many opportunities of noting the sheds to which the engines were attached and also the links in which they generally worked.

"Early in 1903, 33 *Erebus*, 675 *Ivanhoe*, 1429 *Alfred Paget*, 1432 *Panopea*, 1433 *Daphne* and 1436 *Egeria* were at Bletchley. Four of them did sundry main line duties, often piloting expresses. Nos. 1429 and 1433 were nearly always kept at the Oxford shed and did practically all the branch line work, there being only one Bletchley link to Oxford in those days, which was always worked by a 5 ft. 6 in. tank engine. In the autumn of that year 139 *Cygnet* came to Bletchley, as did also 622 *Prince Alfred*.

"In the spring of 1904, 806 *Waverley* was stationed at Bletchley, Nos. 1429, 1432 and 1436 having meanwhile left for Crewe Works for scrapping. The last state of 1436 beggars description, for seldom have I seen such a 'crock,' or heard such blowing and knocking! About October of that year 229 *Watt* also came to No. 3 shed, and at the end of the year Nos. 622 and 806 went to Crewe for withdrawal. I remember it was stated that each of these engines broke their frames, and in view of the remarks made by Mr. Ahrons as to the lateral wobble, I do not doubt that this may have been the case.

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"1905 saw the arrival at Bletchley of 97 *Atalanta* and 111 *Russell* was also at that shed for a short period. During that year I remember 1433 *Daphne* (after being repaired) going to Willesden for a few months to work on the fruit traffic. Otherwise this engine was never away from Bletchley or the sub-shed Oxford for a period of quite ten years. This engine bore a very good reputation amongst the enginemen, and was said to be the only one of the type which could really be relied upon to work trains on the Cambridge branch, a rather 'tricky' line with the Gamlingay bank going down and the adverse gradient coming up from Bedford to Ridgmont. No. 229 (built November, 1859) was scrapped in October, 1905, after a career of close upon 46 years.

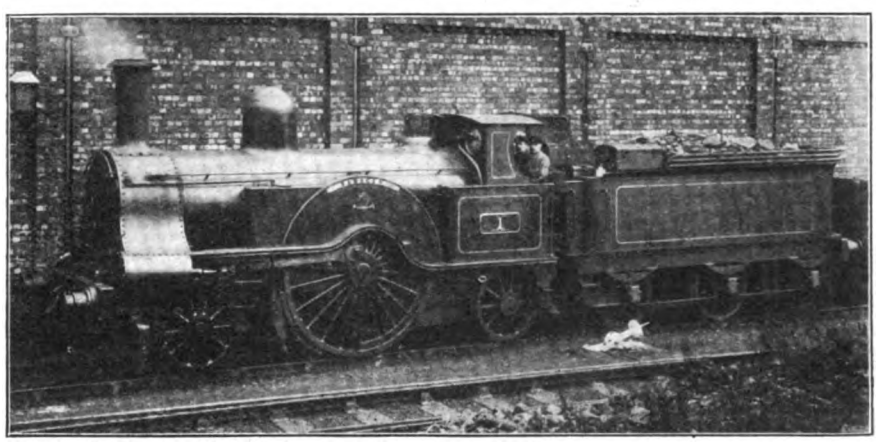
"The last of these famous engines was taken away from Bletchley in 1906. 1433 *Daphne* was sent into the works about March of that year, 139 *Cygnet* about June. 33 *Erebus* about August, and last of all 77 *Mersey* about the end of September. The last-named was a well-known Camden pilot, and I do not think she was at Bletchley for more than 10 or 11 months.

"Although these engines were undoubtedly efficient for their size and weight they were certainly not the marvels some would have us to suppose they were. I have often heard of extraordinary exploits on the part of the Bletchley pilots when working main line expresses after a disabled Compound had been taken off, but I am inclined to think those performances were almost too good to be true. None the less, the 'Ladies' will always be remembered as historical engines, and I am sure that many readers besides, myself, have very much appreciated the lucid articles which have been contributed by Mr. Ahrons to the RAILWAY MAGAZINE."

Mr. C. Williams, of Crewe, also writes: "With reference to Mr. Ahrons' article 'Locomotive and Train Working in the latter part of the 19th Century' (second part), in the February issue of the RAILWAY MAGAZINE, I notice in the lists of 7 ft. and 6 ft. 'singles' (page 140), Nos. 223 *Rose* and 195 *Emerald* are given incorrectly; they should be transposed. The drawing of the *Samson* (page 141) shows this engine as having a number plate, which is incorrect; as originally constructed the number was painted on the panels."

[Mr. Ahrons asks us to explain that he was not responsible for the drawing of the *Samson* reproduced. As regards *Rose* and *Emerald*, he believes the latter was a 6 ft. engine, though the former requires transposition as noted.—ED. R.M.]

The Trevithick "single" No. 353, mentioned on page 21 of the January RAILWAY MAGAZINE, was named *St. Arnaud* not *St. Armand* as there given.



NO. 1 *Saracen*, AS REBUILT AND RUNNING 1896-1904.

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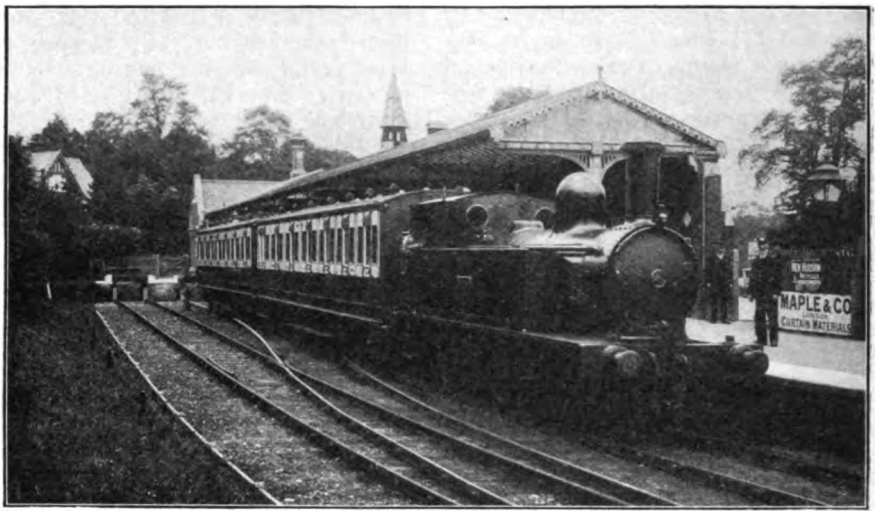

Photo] [*L.N.W R.*

COMPARTMENT MOTOR TRAIN: LONDON AND NORTH WESTERN RAILWAY.

Auto-Trains.

By "VOYAGEUR."

A QUESTION which has always seriously occupied the attention of railway officials has been that of the economical working of branch lines conveying a small traffic, or of suburban lines over which a frequent service of trains is a necessity—whether from road competition or other causes—but on which the number of passengers conveyed per trip is not large. The suburban locomotive, hauling its heavy train of passengers into the city in the morning, and returning with them in the evening, is working to its full capacity, and thereby more or less economically. When the same engine, or one of nearly equivalent power, however, is found working a remote branch line with a train of but two or three coaches, it is safe to surmise that the efficiency of the train, as a traffic "unit," is very low, seeing that the power and weight of the locomotive are so greatly in advance of the limited load requirements.

Again, the intensity of road competition, particularly in the suburban districts of large cities, is such that the railway, if it is to retain any appreciable proportion of its suburban traffic, particularly that from station to station, must provide a train service at very frequent intervals, although but few passengers will require to be conveyed by each train. Here, therefore, we have again the difficulty of the light branch train and the unnecessarily powerful locomotive. Under previously existing conditions of working it could not be met save by designing innumerable types of suburban locomotives for all different classes of work, which was obviously an impossible plan. The essence of its impossibility lies in the fact that, as the traffic on most suburban lines varies enormously during the day, that during "slack" hours bearing no "comparison" to that during "rush" hours, it would be out of the question to keep different sets of engines in steam to deal with the different ranges of load: the enormous increase in working expenses entailed by such a method of working would very far more than swallow up any saving effected by suiting the type of locomotive to the load.

It was probably some consideration of this sort that influenced the late Mr. W. B. Adams to design and build for the Eastern Counties Railway in 1849 his combined engine and coach, for service between London and Enfield. So far as the railway was concerned, however, he was in advance of his time, and for many years the motor-coach was ignored by railway authorities as a traffic unit. But curiously enough, the practice spread to the road, and the steam-tram was quite a recognized method of suburban road traction

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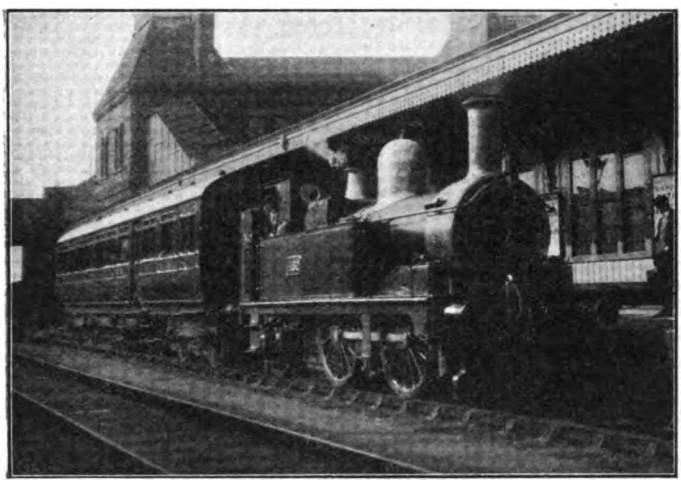

GREAT WESTERN RAILWAY MOTOR TRAIN AT SOUTHALL.
Brentford-Southall Service.

in subsequent years, until the advent of electricity. No further rail motor-cars appeared until the late Mr. Dugald Drummond, with that originality in design which was his chief characteristic, constructed two in 1903 for service on the branch line between Fratton and East Southsea, on which the traffic answered closely to the description given in the previous paragraph. The example thus afforded proved more or less infectious, and before many years had elapsed it had been followed by the majority of the leading lines in the British Isles, together with not a few railways of minor importance.

In many of these cases, however, the move was purely experimental, and the types thus created were not succeeded by further constructions of the same character. The reason for this is not far to seek. In the first place capital expenditure was required, and it was doubtful whether, seeing that these rail-motors were generally first employed on branch services of a poorly-paying character, the economy in running expenses was adequate to pay the interest on this expenditure, let alone effect any saving in general expenses. In the second place, the failure of a motor-engine immediately put the coach also out of commission, except in certain cases where ingenious arrangements were made for substituting a fresh motor-engine in the case of a breakdown. But this had its own disadvantage in that a spare engine had to be kept in waiting, which was not suitably designed to cope with ordinary traffic working, and so was always idle, except on such occasions as a breakdown occurred. In the third place, the rail-motor possessed no "elasticity" as a traffic unit: certain of the vehicles were furnished with engines of sufficient power to haul a trailer coach in addition, but, generally speaking, the rail-motor was unable to meet any considerable variations in traffic demands, with the result that an ordinary train had to be substituted in all cases where an exceptional number of passengers required to be conveyed.

Briefly expressed, the rail-motor was found to be a vehicle of such limited uses that the cost of its construction was not held to be justified. Certain advantages, however, which the rail-motor had yielded were not lightly to be overlooked. Actual working expenses had, of course, been reduced by the employment of a locomotive proportionate in power to the work it had to perform. The greatest advantage, however, had been found to lie in the "handiness" of the new vehicle: it could be driven from either end with equal facility, thereby avoiding the troublesome operations of "running the engine round" its train at terminal stations. In this way economies were effected in the maintenance of permanent way, points and crossings, signal fittings and operations, and, above all, in time, enabling train services at frequent intervals to be maintained, and entailing but the briefest times for reversing the train at the terminals.

Here, therefore, may be found the *raison d'être* of the type of train which forms the subject of the present article, and which is known variously as the "auto-train," "motor-train," or "auto-car." One is at a loss to discover the reason for employing the prefix "auto-" in the description, but as a distinctive title "auto-train" is, perhaps, well-chosen—in contradistinction to the earlier and better known "rail-motor"—and is likely to stick permanently to the new type of vehicle. Similarly to the rail-motor, the "auto-train" enjoys the advantage of being driven from either end, but the expenditure required for its equipment is very small, so that it is not open to criticism on the score of constructional expense.

The auto-train consists of an engine to which are permanently attached, for the

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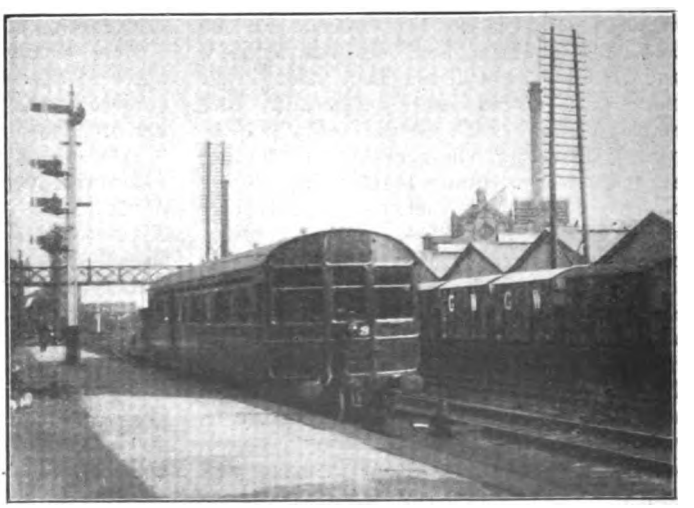
time being, one, two, three, four or even six coaches. These coaches are marshalled in various ways, as, for instance, one only on one side of the engine; in the case of two, one on either side of the engine or both on one side; or in the case of four or six, two or three each respectively on either side of the locomotive. Such details will be considered later, however: it is sufficient at this point to remark that the outward end of the last vehicle is arranged with a driver's compartment, in which are fitted connections to the regulator handle, reversing gear, brake valve and whistle on the locomotive. If the engine is flanked by coaches on either side, drivers' compartments are arranged at each end of the train, the driver being thus separated altogether from the fireman, whereas when the coach or coaches are marshalled on one side of the engine only, the driving is effected alternately from the compartment in the end coach, and, when the train is running in the reverse direction, from the footplate.

Thus there has been evolved a traffic "unit" which is in every respect as "handy" as the rail-motor, but which boasts certain advantages peculiar to itself. In the first place, it is not essential to provide any new motive power or rolling stock. Small tank locomotives which were rapidly becoming obsolete, and which had been withdrawn from local passenger train operation, owing to the more exacting demands of the present day in the matter of load and speed, may now be, and in many instances are, usefully employed in auto-train haulage. Similarly, old carriage-stock, with slight structural alterations, may be employed for the same purpose. The only necessary cost incurred in equipping the auto-train, therefore, is that of altering the coaches for driving purposes, and arranging the required connections between the driving compartment or compartments and the locomotive cab. the whole, of course, involving a trifling expense as compared with that of building a rail-motor coach. In the second place, the engine is easily detachable, and may be detached and utilized for shunting purposes when necessary, while also, in the event of a locomotive failure, a fresh engine can without difficulty be substituted. If the latter is not fitted for auto-working, the train must, of course, be worked in the ordinary manner, but it will be seen that the disablement of the auto-engine does not involve the idleness of the coaching stock. In the third place, the auto-train is, within certain limits, elastic in the matter of accommodation. That is to say, the reserve of power possessed by the engine in most cases is sufficient for the haulage of extra coaching stock when necessary. If the extra vehicles are not fitted for auto-working, they must of necessity be attached as trailers.

All these reasons considered, therefore, it is not surprising that the auto-train has altogether superseded the rail-motor in the favour of railway officials, and very few of the latter have been constructed for several years past. Just as the London and South Western Railway set the fashion in introducing the rail-motor, the same company probably helped to bring about the change to auto-working. Mr. Drummond had experienced the difficulties of rail-motor working both in the matter of non-flexibility of accommodation and of uselessness of the engine for any purpose other than that of working the motor-coach, and so he designed and built in 1906 a small 2–2–0 type engine, and has since followed this type with one having the 0–4–0 wheel arrangement, with the special object of working lightly-loaded short-distance train services. These engines were not equipped for auto-working when



GREAT WESTERN RAILWAY MOTOR TRAIN WITH ENGINE IN REAR.

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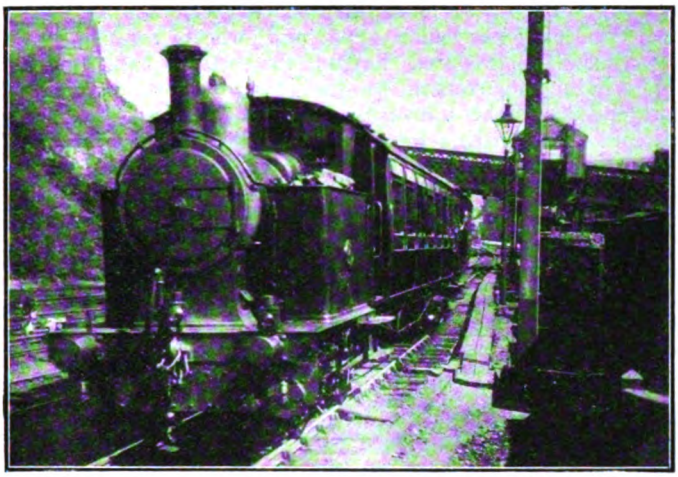

Photo] [*R. W. T. Collins.*

SOUTH EASTERN AND CHATHAM RAILWAY RAIL-MOTOR-CAR ON RYE-HASTINGS SERVICE.

built, but several have since been so equipped, and are now employed in working auto-trains. They are the only engines which could be said to have been specially built for the purpose: on almost all other lines engines of types rapidly becoming obsolete have been employed. Another curious case is that of the Rhymney Company, which built a rail-motor coach, but, after experiencing similar difficulties to those recounted above, separated the engine from the body, rebuilding the former as a small 2–4–0 type tank locomotive, and the latter as an ordinary bogie coach.

In order to show the almost universal conversion that has taken place among the leading railway companies from rail-motor to auto-train working, it may be well at this point to mention the lines which employ both methods of operation. Rail-motor coaches were built principally by the Great Western, London and North Western, London and South Western, and Lancashire and Yorkshire Railways; and also, more or less experimentally, by the Midland, Great Northern, Great Central, London, Brighton and South Coast, South Eastern and Chatham, North Staffordshire, and Furness Railways in England; the Taff Vale, Barry and Rhymney Railways in Wales; the Glasgow and South Western Railway; and the Great Southern and Western, and Belfast and County Down Railways in Ireland. Many of these lines have since inaugurated auto-train services, having at the same time ceased to construct further rail-motors, except the Lancashire and Yorkshire, Great Northern, Furness, Barry, and the two Irish Railways, but at the same time new adherents to the auto-train principle have been found in the North Eastern, Cambrian, and Great Northern (Ireland) Railways. The latest convert to auto-working is the Great Eastern Company, who recently instituted an auto-train service on the Cambridge and Mildenhall branch, the combination being at present temporarily employed between Lower Edmonton and Cheshunt.

Before entering into details of working, some of the chief arguments in favour of the auto-train may be recapitulated. Most of these arguments apply also to the rail-motor, although the special advantages of the auto-train as compared with the rail-motor have already been dealt with. In the first place, as in the case of the London, Brighton and South Coast and London and North Western London suburban services, the auto-train is a valuable traffic "unit," as a go-between where the substitution of electric for steam traction is contemplated. It may be employed for working a local service at frequent intervals, practically the whole of the time and wear and tear involved in running the engine round the train at terminal stations being economised. Should the traffic developed by the auto-train service be held sufficient to justify the substitution of electric for steam operation, it will have been attracted in about the most economical way possible, whereas, if the development does not come up to anticipations, the auto-trains may be retained as still being the most suitable and economical method of working. The waste of money spent on electrification, in view of a possible but not certain increase in traffic, may thereby be obviated.

In the second place, auto-trains stationed at provincial centres may prove themselves very useful agents for collecting and distributing traffic. They may be used as feeders to main-line trains, being sent out from junction stations to neighbouring stations on the main line, both distributing and collecting passengers, irrespective of whether running-round facilities are provided

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at such stations or not. They may be usefully employed to work up local services on branch lines, and traffic may thus be developed by the erection of "halts" between stations, which are more suitably served by a train of the auto pattern than by one of the ordinary type. In the third place, instead of capital expenditure being involved, an increased life at trifling expense may be obtained for otherwise obsolete locomotives and out-of-date coaching stock which, after re-fitting, are well suited to light service such as this. As regards locomotives, in only one case previously mentioned have new engines been designed and built for auto-working, but it must be admitted that, up to the present, it has been the exception among British railway companies to utilize out-of-date coaches for the purpose. This consideration, however, barely affects the question, as the building of new coaches for auto-working by no means precludes their use for ordinary purposes.

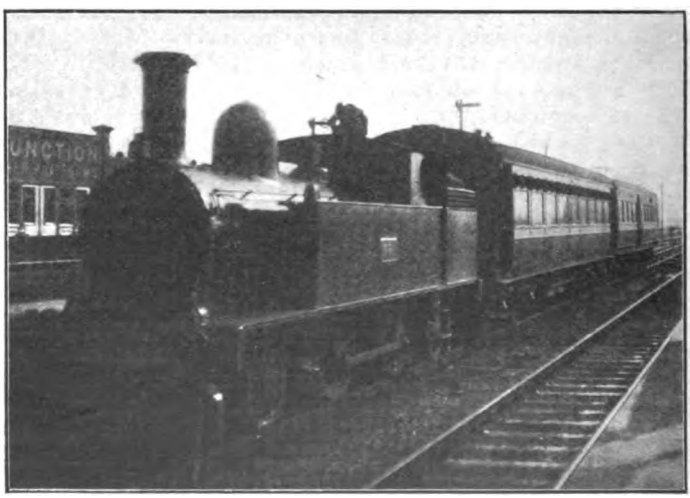
With the undoubted advantages mentioned above, it is not surprising to learn that definite economies have been effected by the substitution of auto-train working for that of the ordinary locomotive and train, amounting in certain instances to as much as one-half the previous cost of running per mile. In such a case, therefore, a train service may be doubled, without any increase on the original cost of working, by the adoption of auto-trains, or an increase of fifty per cent. in the number of trains may at the same time be accompanied by a substantial curtailment in working expenses. This combination of enhanced efficiency with economy, therefore, is quite sufficient to account for the increasing popularity of auto-train working. With these introductory remarks, we may proceed to a more detailed consideration of the practice of the various companies as regards locomotives and coaching stock employed and general methods of operation.

(A) Locomotives.

The locomotives employed for the purpose of auto-working by the different companies concerned are of considerable variety. In every case tank locomotives have been utilized, the particular type and wheel arrangement favoured having in certain cases been governed by the class of work on which the auto-train was to be used, and in others by whatever suitable type of engine could be spared for the purpose. As previously mentioned, the London and South Western Railway has been the only line to build engines specially for the purpose of auto-working; in a number of instances on other companies' systems engines which were rapidly becoming outclassed in the haulage of suburban trains owing to the increasing demands on their powers in the matter of weight and speed, have had suitable employment found for them in the haulage of auto-trains.

The ideal types of engine for short distance services are undoubtedly those of the 0–6–0, 2–4–0, or 0–4–2 wheel arrangements, as these carry suitably small supplies of coal and water. For services with many intermediate stops, necessitating rapid acceleration from rest, the small-wheeled six-coupled type is the more suitable, whereas for services having longer intermediate runs, the four-coupled engines find greater favour, as being capable of higher maximum and average speeds. The London, Brighton and South Coast Railway Company has converted certain 0–6–0 tank engines to the 2–4–0 wheel arrangement by the simple expedient of removing the leading side-rods, presumably with the last-mentioned object in view.

Six-coupled tank engines (0–6–0 type) are employed by the Great Western Railway on



LONDON AND NORTH WESTERN RAILWAY MOTOR TRAIN (CORRIDOR COACH TYPE) AT WATFORD JUNCTION.

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LONDON AND NORTH WESTERN RAILWAY FOUR-COACH MOTOR TRAIN. COMPARTMENT TYPE.

the services in the neighbourhood of Plymouth and Devonport, which are probably the heaviest regularly worked on that system with auto-trains. These engines have cylinders 16½ in. diameter by 24 in. stroke, and driving wheels 4 ft. 1½ in. diameter. The boiler affords 857 sq. ft. of heating surface, and the firebox 96 sq. ft.—total 953 sq. ft.; the fire-grate area is 14·7 sq. ft., and the working pressure 165 lbs. per sq. in. The tanks have a capacity for 1,000 gallons of water. A similar, but more powerful type is in use in the Midlands, having cylinders 17 in. diameter by 24 in. stroke, 4 ft. 7 in. driving wheels, a total heating surface of 1,120 sq. ft. (divided in the proportion of 1,024 sq. ft. in the boiler to 96 sq. ft. in the firebox), a grate area of 14 5 sq. ft., and a working pressure of 150 lbs. per sq. in. The tank capacity of these engines is one of 800 gallons, and that of the coal bunker 2 tons, while the total weight of the engine is one of 46½ tons in working order.

A very small but eminently suitable type of six-coupled tank engine in use for this purpose is that employed on certain services by the London, Brighton and South Coast Company. The engines in question were at one time generally known as the "Terrier" tanks, but, modern suburban train services being quite beyond their powers, they were rapidly being either sold out of the service or broken up. Several have been retained for auto-working, however, and have the following dimensions:—Cylinders, 12 in. diameter by 20 in. stroke; driving wheels, 4 ft. 6 in. diameter; heating surface, tubes 463 sq. ft., fire-box 55 sq. ft.—total 518 sq. ft.; grate area, 10 sq. ft.: working pressure 150 lbs. per sq. in.; tank capacity, 500 gallons; bunker capacity, 1 ton; weight in working order, 27 tons. For a light service, few types of engine could be more suitably designed as regards tractive effort and fuel and water supply. Where greater intermediate speed is required, the leading side-rods in one or two cases have been removed, as previously mentioned, thus converting the engines to the 2–4–0 wheel arrangement. Six-coupled tank engines of similar size and power are also used on the South Eastern and Chatham Railway for auto-train purposes, the design being one initiated by Mr. Wainwright during recent years for the economical working of light branch services.

The six-wheeled four-coupled types in use are numerous, particularly those of the 2–4–0 wheel arrangement, which generally indicates a relatively small bunker capacity. The London and North Western Company has converted a number of 2–4–2 type engines to the 2–4–0 type by curtailing the size of the coal bunker, thereby reducing the weight of the locomotives in working order from 46 to 33 tons. These engines, and the original 2–4–2 type engines, which are the only type in use on the London and North Western Railway for auto-train haulage, have cylinders 17 in. diameter by 20 in. stroke, and driving wheels 4 ft. 6 in. in diameter. They have been withdrawn from suburban and branch working in favour of the large and powerful 4–4–2 and 4–6–2 tank engines now in service. On the Great Western Railway, also, several 2–4–0 locomotives of the type once familiar in the London suburban district are now employed on auto-trains. They have cylinders 16 in. diameter by 24 in. stroke, driving wheels 5 ft. diameter, a total heating surface of 1,308 sq. ft., and a working pressure of 150 lbs. per sq. in., weighing 39½ tons in working order. Engines having a similar arrangement of wheels are also in use for auto-working on the Great Central and Cambrian Railways.

The 0–4–2 wheel arrangement is favoured by the Great Western and London, Brighton and South Coast Railways, the engines in each case being of fairly powerful types, with

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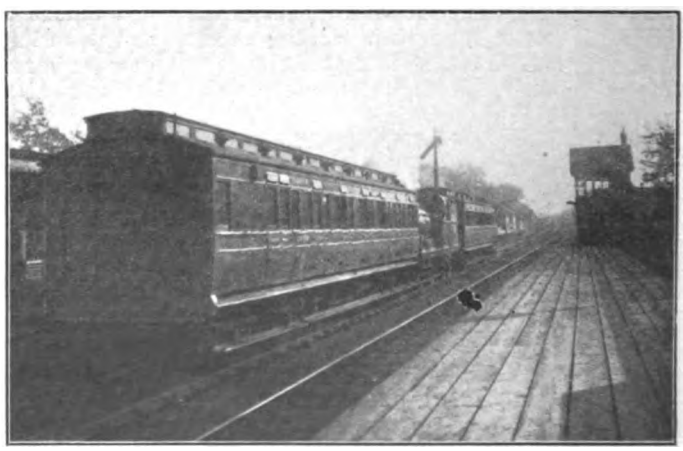
driving wheels of a good size, and thus well adapted for maintaining rapid communication over routes where the stops are not too closely situated to each other. Great Western engines have the following dimensions :—Cylinders, 16 in. diameter by 24 in. stroke ; driving wheels, 5 ft. 2 in. diameter ; heating surface, tubes 1,007 sq. ft., fire-box 87 sq. ft.—total 1,094 sq. ft. ; grate area, 13·14 sq. ft. ; working pressure, 150 lbs. per sq. in. ; tank capacity, 620 gallons ; bunker capacity, 1 ton ; and weight in working order, 36 tons. The dimensions of the London, Brighton and South Coast 0–4–2 engines are as follows :—Cylinders, 17 in. diameter by 24 in. stroke ; driving wheels, 5 ft. 6 in. diameter ; heating surface, tubes 952 sq. ft., firebox 91 sq. ft.—total 1,043 sq. ft. ; grate area, 13 sq. ft. ; working pressure, 150 lbs. per sq. in ; tank capacity, 860 gallons ; bunker capacity, 1½ tons ; weight in working order, 42½ tons.

The most powerful engines in use for auto-working are those of eight-wheeled types, principally the 0–4–4, but also the 4–4–0 and 2–4–2. The two companies using 0–4–4 type engines are the North Eastern and the Midland. The North Eastern Railway has adapted the 0–4–4 type tank engines of the late Mr. Fletcher's design, which had otherwise become obsolete, for auto-car working, and now uses them exclusively for this purpose. The engines in question are of the well-tank type, with cylinders 16 in. diameter by 22 in. stroke, and driving wheels 5 ft. diameter, working at 140 lbs. per sq. in. pressure. They have coal bunkers of good size, accommodating 2½ tons, also a very fair water capacity of 960 gallons, enabling journeys of a considerable length to be undertaken. They weigh 46¼ tons each in working order. The Midland 0–4–4 engines are of the standard pattern, and quite the largest and most powerful engines in use for auto-working. They have cylinders 18 in. diameter by 24 in. stroke and driving wheels 5 ft. 4 in. diameter. The boilers have a tube heating surface of 1,142 sq. ft. and a firebox surface of 110 sq. ft., total, 1,252 sq. ft., with a grate area of 16 sq. ft. The working pressure is 150 lbs. per sq. in. They have a capacity for 1,270 gallons of water, and 2 tons of coal, and weigh in working order 55¼ tons.

The only lines employing 2–4–2 type tank engines are the Great Eastern and London and North Western, but, on the majority of the services of the latter company, the engines converted to the 2–4–0 wheel arrangement are employed. The 4–4–0 engines in use are but few in number, and of very early types, this being an arrangement of wheels for tank engines which was more in favour in the mid-Victorian period than of recent years. Engines of this pattern may be found working auto-trains on the Taff Vale, Great Northern (Ireland), Glasgow and South Western and Midland Railways. That in the last-named instance was purchased from the Midland and Great Northern Joint Railway for the purpose, and works attached to an old Pullman car, which has been re-seated—a noteworthy instance of longer life being economically secured for out-of-date stock, both locomotive and coaching.

The engines mentioned as having been specially built by the London and South Western Railway Company for auto-train working are of small four-wheeled types—both 2–2–0 and 0–4–0—generally similar in dimensions and power to those built into the rail-motor vehicles. They have cylinders 10 in. diameter by 14 in. stroke and driving wheels 3 ft. diameter in the case of the "single" engines, and 3 ft. 6 in. diameter in the case of the coupled engines. The boilers are arranged according to the late Mr. D. Drummond's water-tube plan, the heating surface afforded by the tubes being 379 sq. ft., the fire-box 73 sq. ft., and the cross water-tubes 119 sq. ft., total 571 sq. ft. They work at a pressure of 150 lbs. per sq.



NORTH EASTERN RAILWAY AUTO-TRAIN.

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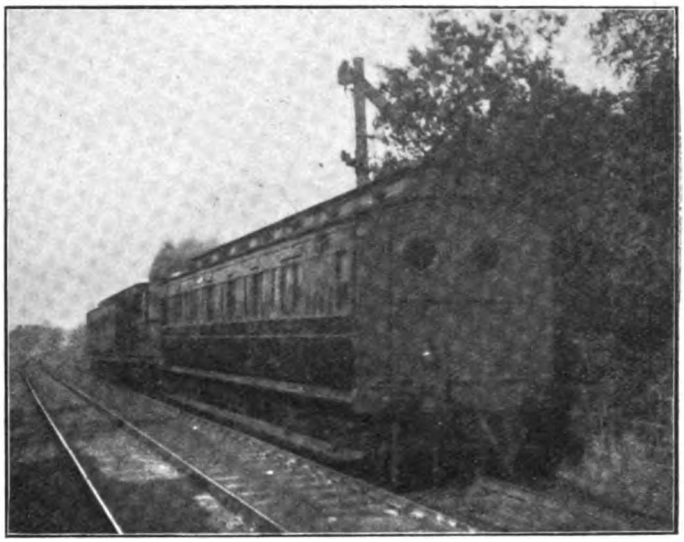
in. With a tank capacity of 500 gallons and a bunker capacity of 1 ton, the weight in working order is 25 tons, and these little machines, therefore, correspond fairly closely with the "Terrier" tanks of the London, Brighton and South Coast line, save only in the matter of cylinder dimensions. It will be seen that the engines employed for auto-working cover a wide range in working capacity and tractive power.



NORTH EASTERN RAILWAY DOUBLE-ENDED MOTOR TRAIN.

(B) Coaching Stock.

The coaching stock employed by the different companies for auto-working is also very varied in character, but, in contra-distinction to the practice with locomotives, it has been the exception rather than the rule to utilize out-of-date carriages for the purpose. In the first place it is necessary, where coaches are to be pushed by the engine in ordinary running, that their wheel-base should be suitably flexible, and this flexibility is best obtained by the use of bogie rolling stock. As the bogie type of vehicle is even yet comparatively modern in character, as compared with the earlier four and six-wheeled types with rigid wheel-bases, there have not, in many instances, been stocks of out-of-date bogie vehicles to draw from for the purpose, and it has therefore been convenient, in such cases, to build suitable rolling-stock for auto-working. In certain isolated instances, however, six-wheeled vehicles have been equipped for auto-operation. As previously mentioned, also, special stock thus built may without difficulty be employed for ordinary purposes, and need never stand idle when not required for use on an auto-train. In the second place, it has been thought desirable on certain services, as we shall see later, to allow for the issue and collection of tickets *en route*, for which purpose corridor coaches of the open type are required; this again has necessitated the construction of special rolling stock.

The only lines which have used ordinary coaching stock, after re-fitting the coaches for auto-working, are the North Eastern, Great Eastern, and Midland (on all services) and the London and North Western and London, Brighton and South Coast (on certain services). The auto-coaches of the North Eastern Railway were converted from 8-compartment bogie third-class vehicles, 52 ft. long, weighing 25¼ tons each. The seating of and partition between the two adjacent compartments at one end of the coach were removed to form a combined driving and luggage compartment. The former is entered from the latter, although partitioned from it, and the luggage space is of fair size, being 10 ft. long, and entered from the platform by double doors. The compartment adjacent to the luggage compartment has been re-upholstered and converted to first class, leaving five third-class compartments: the car therefore accommodates 8 first and 50 third-class passengers. Either one or two coaches are employed to form an auto-train, those in the latter instance being marshalled one on either side of the engine. The coaches employed on the Midland are of similar pattern, save that they have two first and four third-class compartments, seating 16 and 40 passengers respectively. They are of lighter construction, weighing only 18½ tons each, and are usually run in pairs, one on either side of the locomotive.

(*To be continued.*)

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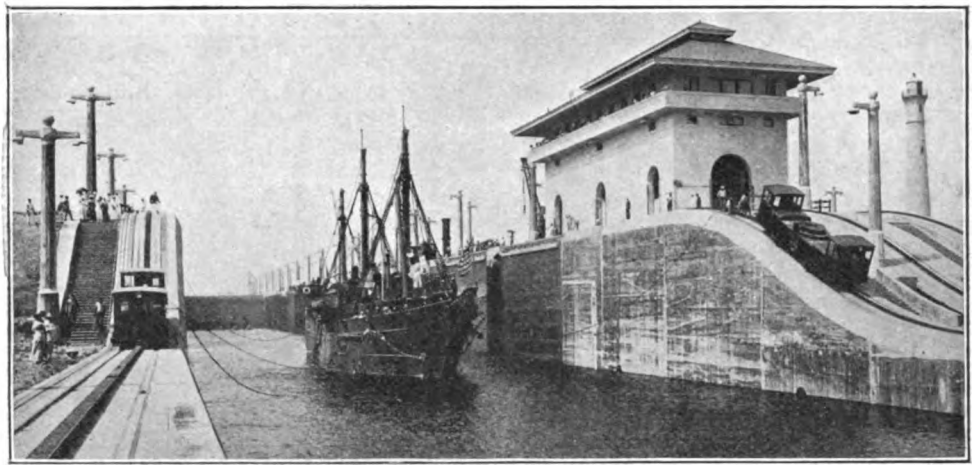

OPERATION OF GATUN LOCKS.

Showing the U.S. tender *Severn* leaving Upper East Chamber in tow of electric locomotives.

Railway Electrical Progress and Practice.

By "INDICATOR."

SO far we have dealt in these articles with various aspects of electric traction on railways, with the use of telephony in connection with the working of the "train control" system, with certain phase of power signalling, and in our last issue Mr. J. F. Gairns described the work and scope of the electrical department of a great railway, that presided over by Mr. R. H. Houghton, Electrical Engineer to the London, Brighton and South Coast Railway, being selected. This month a complete change of venue and of subject is made; and attention may be directed to one of the most remarkable examples of a special adaptation of electric locomotive traction that the world s practice has yet seen. This is the electric towage system installed on certain sections of the recently-opened Panama Canal, connecting the Atlantic and Pacific Oceans across the isthmus of Panama.

This great undertaking has received special attention in the public press of all countries, so that there is no need to review its general features, nor to refer to the numerous difficulties overcome in its construction and the equipment as a whole. It will be sufficient to summarise the general features of a passage through the canal, in order that the part played by the electric towage system may be appreciated.

In passing through the canal from the Atlantic to the Pacific, a vessel enters the approach channel in Limon Bay, which extends to Gatun, a distance of about 7 miles. At Gatun it enters three locks in series, wherein it is raised 85 ft. to the level of Gatun Lake. Thence a vessel can steam at full speed through the channel in this lake, for a distance of 24 miles, to Bas Obispo, where it enters the Culebra Cut. This has a length of 9 miles, and extends to Pedro Miguel, where a lock is installed for lowering a distance of 30 ft. Miraflores Lake is then traversed for $1\frac{3}{4}$ miles, and at Miraflores two locks are provided for lowering a further 55 ft. to sea level, whence an $8\frac{1}{2}$-mile channel leads to the Pacific outlet.

As an alternative to the almost prohibitive scheme for constructing a sea-level canal for the whole distance, the principal operative problem was that of manœuvring ships through the locks of the canal. It became evident that they should not proceed through the locks under their own power, and that a substitute for the ship's power should embrace the following requirements: (*a*) ability to place the ship in proper relation to the lock; (*b*) capability

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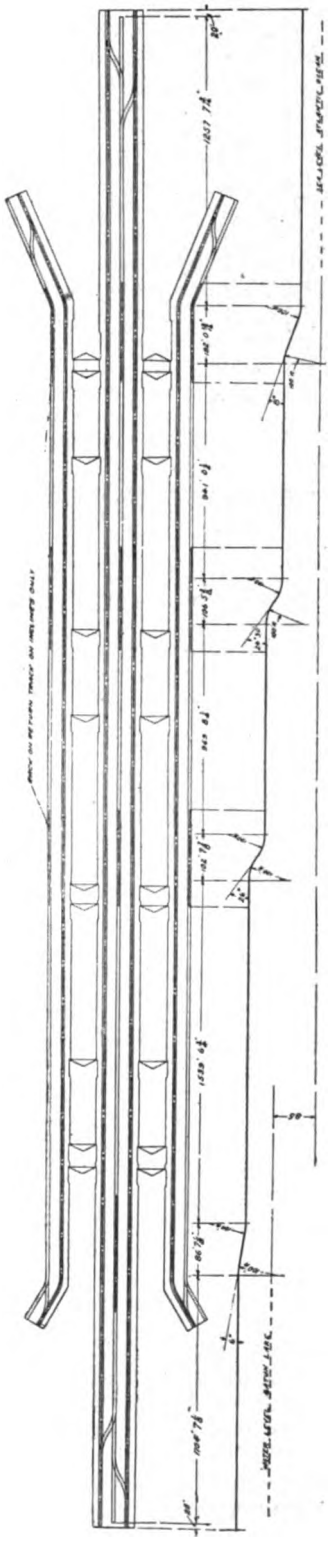

PLAN OF GATUN LOCKS, SHOWING TRACKS FOR ELECTRIC TOWING LOCOMOTIVE.

of keeping the ship to its course; (*c*) accelerating and retarding the ship without rupturing the lines; (*d*) the lines, when once attached, should be used without change through a series of locks; (*e*) a small number of skilled operators is preferable to a large number of unskilled men.

Eventually it was decided to adopt the electric towage equipment now installed, this being designed by Mr. Edward Schildhauer, Electrical and Mechanical Engineer to the Isthmian Canal Commission. The forty towing locomotives and all the electrical apparatus for operating the locks were built by the General Electric Company, Schenectady, N.Y., U.S.A. We are indebted to the British representatives of this firm, the British Thomson-Houston Co., Ltd., for information upon which this article is based and for illustrations reproduced herewith.

The main features of all the lock sites are identical; and the following brief description of the Gatun Locks, with special reference to the arrangement of the towing tracks, ship channels, inclines and approaches, is given to enable a clearer conception of the towing scheme in general to be obtained.

The lay-out of the Gatun Locks is shown in the diagram on this page. There are two ship channels, one for traffic in each direction. These channels are separated by a centre wall, the total length of which is 6,330 ft. There are two systems of tracks, one for towing and the other for the return of the locomotive when returning idle. This, however, refers only to the outer walls. For the centre wall, there is only one return track in common for both the towing tracks. The towing tracks are naturally placed next to the channel side, and the system of towing utilises normally not less than four locomotives running along the lock walls. Two of them are opposite each other in advance of the vessel, and two run opposite each other following the vessel. The number of locomotives is, however, increased when the tonnage of the ship demands it.

Cables extend from the forward locomotives, and connect with the port and starboard sides respectively of the vessel near the bow, and other cables connect the rear locomotives with the port and starboard quarters of the vessel. The lengths of the various cables are adjusted by a special winding drum on the locomotive to place the vessel substantially in

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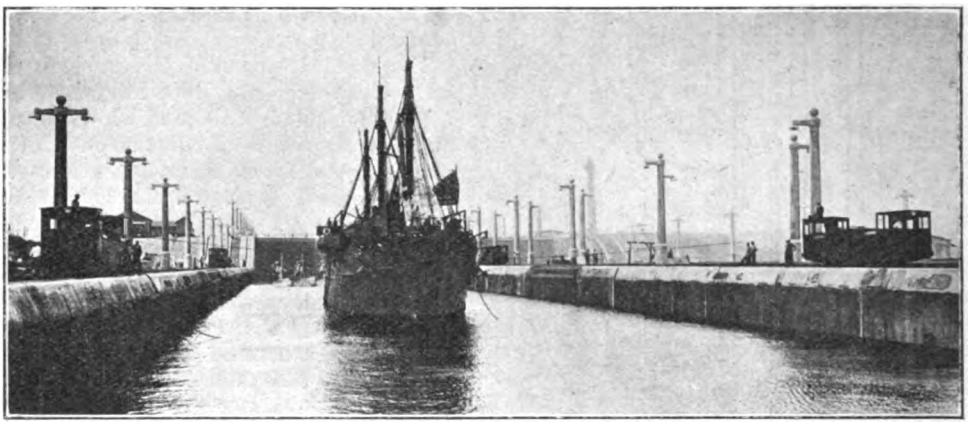
mid-channel. When the leading locomotives are started, they tow the vessel; while the trailing locomotives follow and keep all the cables taut. By changing the lengths of the rear cables, the vessel can be guided; and to stop the vessel, all the locomotives are slowed down and stopped, thus bringing the rear locomotives in action to retard the ship. Therefore, the vessel is always under complete control quite independent of its own power, and the danger of injury to the lock walls and gates is very greatly lessened.

The towing tracks have a specially-designed rack rail extending the entire length of the track and located centrally with respect to the running rails. It is through this rack rail that the locomotive exerts the traction necessary for propelling large ships and climbing the steep inclines.

A rack rail is also provided on short portions of the return track so as to lower the locomotives safely from one level to the next. The steepest slope is 26 degrees, or 44 per cent., hence the need will be seen for rack rail even on the return track, it being noted that any traction locomotive with the usual wheel drive, even with the brakes set, would begin to slide on a 16 per cent. grade, and, therefore, could not be controlled. With a rack rail, however, traction is limited only by the capacity of the driving motors, and not by the adhesion of the wheel treads on the rails.

These rack rails are fitted with a hinged approach rail adapted to be depressed on the approach of the rack pinion of the locomotive. The teeth of the approach section are under size and shaped off at the extreme end, so that the teeth of the pinion will mesh properly and prevent excessive strain on the pinion and the axle. A spring restores the approach to the proper position after the locomotive has passed over. The rack rail is of the shrouded type. A further feature of the rack rail is the projecting edges, which permit thrust wheels attached to the locomotive to run along the under side and prevent overturning of the locomotive, in case some unforeseen operating condition should produce an excessive pull on the towline. These thrust wheels serve to counteract the lateral component of the towline pull and the flanges act for emergency only, as the weight of the locomotive is, however, sufficient to prevent overturning with a normal pull of 25,000 lb. on the towline.



OPERATION OF GATUN LOCKS.

The *Severn* and submarines in Middle East Chamber. Four towing locomotives are attached to the *Severn* ready for lowering water.

Three-phase, 25-cycle, 220-volt alternating current is supplied to the locomotives through an underground contact system. This is placed adjacent to the running rail on the side remote from the lock. Two T-rails form two legs of the three-phase circuit, and the third leg is formed by the main track rails. A specially-designed contact plough slides between the two "T" conductors and transmits the power from the rails to the locomotive. This contact plough also passes through the slot opening in the conduit cover, and is flexibly connected to the locomotive in such a manner as to follow all irregularities in the tracks and crossovers, and therefore insures a continuous supply of power.

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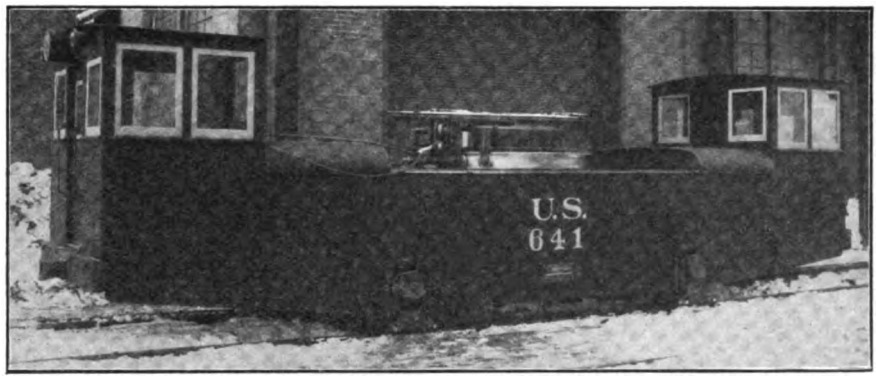


ELECTRIC TOWING LOCOMOTIVE AT THE BUILDERS' WORKS, READY FOR SHIPMENT.

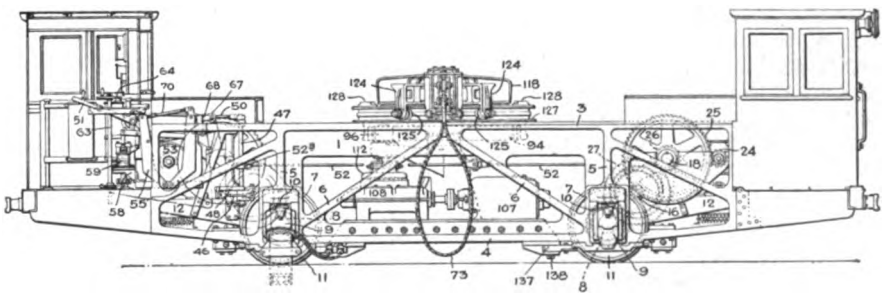
The locomotives are four-wheeled and each axle is driven by its own motor, independent of the other, construction being identical at both ends. The motor is of the three-phase, slip-ring type, and drives the rack and traction wheels by specially designed gearing, so that the motors will propel the locomotive by the adhesion between the wheels and the rails of the track when running without load and between inclines, or by means of the rack mechanism.

When the locomotive reaches one of the inclines between the locks, the grade of which may be as much as 44 per cent., or when it is towing a ship, the rack rail system is utilised to enable the locomotive to climb the grade and exert traction necessary for pulling large ships.

The two traction motors are controlled by controllers installed in the cabs at the ends of the locomotives, and the circuits are such that both motors can be controlled from either cab, and can be operated singly or in multiple as desired. Each motor, with all its gearing and clutches, is mounted independently of the frame of the locomotive, to which it is connected only by springs, which give an elastic support for the outer end of the bracket on which the mechanism is carried. In connection with each motor a powerful brake is installed; and, as during operation the motors are at all times geared either to the axles or to the cog wheels, the truck wheels are not provided with any brake rigging.

In addition to an automatic brake system, means are provided for applying the brakes manually in order to supplement the action of the automatic feature, if necessary, when descending a grade or where approaching a rack rail.

Passing now to the features which render the locomotive peculiarly adapted for towing purposes, the cable is wound on a drum located midway between the ends of the locomotive and above the upper member of the side frames, so that the cable can be led off on either side of the machine and through a wide range of angles to the line of travel. A motor with bevel gear pinion is used for driving the drum at a high speed when coiling a cable which has been cast off, and it remains permanently in gear. Another motor, with worm-gear drive, is used for taking in the cable when it is under load, and the drum operates as a windlass



GENERAL DRAWING OF ELECTRIC TOWING LOCOMOTIVE.

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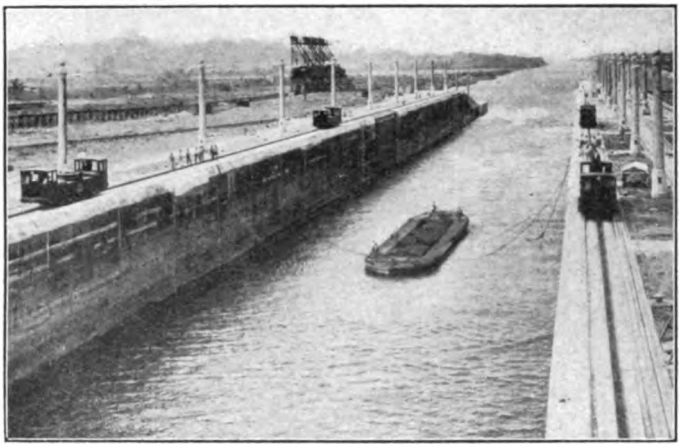

TOWING LOCOMOTIVES PASSING BARGE THROUGH GATUN LOCKS TO ATLANTIC LEVEL.

or capstan. Due to the greater gear reduction, it operates the drum at a much slower speed; and, consequently, with motors of approximately equal size, a greater force may be exerted on the towline than would be possible with the lower speed reduction which is used with the high-speed coiling motor. The worm-gear drive is disconnected from the drum when not in use. The guide which directs the cable, as it pays out or winds up, is mounted so as to revolve on the axis of the drum.

The rapid-coiling motor is permanently geared to the drum and is of the same type, size and capacity as the winding motor. It is subjected to its maximum load when accelerating the heavy drum to the high speed required for coiling or paying out the rope, this being sixteen times the slow winding speed at full load, or about 200 ft. per minute. The slow-winding and the rapid-coiling motors are operated by similar controllers, and the circuits electrically interlocked so as to prohibit application of power to either motor unless the controller of the other motor is in the "off" position.

Each of the two main traction motors has a rating of 75 horse-power, and is of the slip-ring induction type, operated by a system of contactors with master controller in each cab. The motors, by means of the change in gearing from straight traction to rack-rail towing previously described, drive the locomotive at a speed of two miles per hour when towing and five miles per hour when returning idle. These motors act as induction generators running above synchronous speed when the locomotive is passing down the steep inclines, and thereby exert a retarding brake effect to keep the speed uniform.

The towing locomotives, as described and illustrated, possess the following operating characteristics:—

(1) While towing, the speed can be regulated from zero miles to two miles per hour.

(2) While running idle, the speed can be regulated from zero to five miles per hour, permitting return trips at increased speed.

(3) The windlass will pay out or wind in cable at the low-rope speed and at the full towline pull of 25,000 lb., either when the locomotive is running or at rest.

(4) The windlass will pay out or coil in cable at the high-rope speed with the towline taut, either when the locomotive is running or at rest.

(5) The windlass is equipped with a safety friction device, which is adjustable to any predetermined value of the towline pull.

The first impression may be gathered that these machines are somewhat complicated; but, considering their many functions and the great flexibility for performing them, the design is in reality peculiarly simple. The locomotives have fully demonstrated in actual operation that the requirements contemplated by the engineers of the Isthmian Canal Commission have been successfully met.

The locomotives have a net weight of 86,300 lb., and a gross shipping weight of 92,500 lb. They were mounted on specially-designed skids and shipped by rail to New York, where they were loaded on board the ships as deck cargoes by means of a 125-ton floating derrick.

During the first three months of commercial operation of the Canal, from August 15th to November 15th, the cargo transported through the Canal and towed through the locks by the locomotives amounted to 1,079,521 tons. During the fiscal year ending June 30th, 1914, the Panama Railroad carried 643,178 tons of through freight between the two seaboards, and in the preceding fiscal year 594,040 tons. From this it is seen that between six and seven times as much cargo is passing over the Isthmus now as passed over this route when goods were transhipped by rail.

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The Relaying of Railway Permanent Way.

By J. JENKINSON.

FIG. 1. UNFISHING AND UNKEYING.

IN some districts it is not necessary to reconstruct the permanent way more than once in fifteen to twenty years, except for occasional replacement of a rail, but this is only on branch lines over which comparatively little traffic passes. On main lines, used by many trains, it is necessary to relay every 12 to 14 years, and in very busy districts every eight or ten years. In many tunnels, however, a considerable amount of water percolates through the top and sides, and this frequently carries down with it in solution acids and other corrosive substances, which have a deleterious effect on the rails and chairs, although, strange to say, sleepers taken out of tunnels after five or six years wear are often in almost as good condition as when first put in. For this and other reasons it is often necessary to relay the permanent way in tunnels every five years or so.

In order to arrive at a decision as to when existing permanent way must be taken out, and new permanent way laid, a minimum weight per yard per rail is stipulated, and such portions of the line as approach this minimum are relaid. To obtain the weights of the rails each year one or two rails on either road in each section are weighed by means of a steelyard suspended from a tripod. Reports of each weighing, also a rubbing of the rail, are sent to headquarters, who decide which particular sections of the railway shall be relaid during the ensuing year.

The first point in arranging relaying is to order supply of the necessary materials, and for each mile of plain road the following quantities are required, taking the conditions which apply on one of the leading railways by way of example :—234 45 ft. rails ; 2,112 sleepers ; 4,224 chairs ; 4,224 keys ; 8,448 spikes ; 8,448 trenails ; 470 fishplates ; and 940 fishbolts. For other than plain road, crossings, angles, etc., are required, and these are made up at the works and sent to the site complete. The cost of the materials shown above, speaking approximately, is about £1 per yard.

The first materials to arrive on the scene are usually sleepers, which have been creosoted and bored ready for the fixing of the chairs at the port at which they were discharged ex-ship. These are, of course, received in railway wagons which are attached to, and taken to the site by, the ballast train ; and unloaded by the ballastmen between trains. This sometimes occupies a considerable time on portions of the line where traffic is dense, the men having to await the passing of trains for perhaps two-thirds of the day, and are actually unloading one-third. The ballast train gang generally consists of about twenty men, and they are continually employed loading up or discharging permanent way materials, ballast, etc., etc.

After these, the chairs, spikes and trenails arrive, and these are fixed on to the sleepers by the relaying gang. The gang usually arrive on the scene a week or a fortnight before it is expected to relay, and are continuously employed up to the actual day of relaying. Rails are usually the last to arrive, and these are thrown off the trucks into the six-foot by the ballast men. Unfortunately, with rails 45 ft. long and over, a comparatively large percentage are crippled (bent) in being thrown on to the floor, and railway companies are considering

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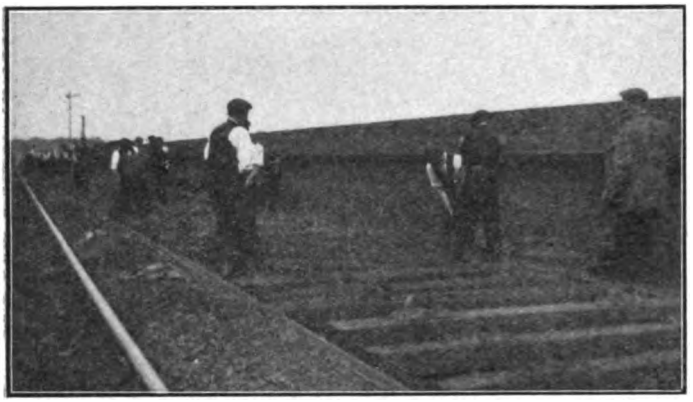

FIG. 2. PUTTING IN NEW SLEEPERS.

contrivances for lowering the rails from the wagons more steadily.

Once all the materials are on the site, relaying proper is arranged for the first convenient Sunday. The ballast between the sleepers is taken out the day previous, and on the Sunday the Traffic Department work all traffic, up and down, on one set of metals, the Permanent Way Department having entire possession of the line they are relaying for the whole day. The dead line is, of course, protected by fog signals, and red banner flags, and all trains running on the facing road have to back across before entering the single line.

Roughly speaking, a hundred men are required to take out and relay a mile of road in twelve hours, except in tunnels, when considerably more men are wanted on account of the conditions under which they are required to work. If, however, it be desired to load up the old material the same day, another fifty men are wanted to complete the work in the time mentioned. Immediately the Permanent Way Department obtain possession of the line, their first duty is, of course, to take out the old permanent way. First of all, fishbolts must be unscrewed, and fishplates taken off; four men will suffice to do this work and keep in advance of the following gangs. The keys must then be knocked out; six men will be wanted to keep in front with this work, as some of the keys, particularly if the weather has been at all wet, expand, and are, consequently, difficult to remove. This permits the rails to be turned out of the chairs. The 45 ft. rails weigh nearly 15 cwt., and twelve or fourteen men are required to lift each of them out and carry to the cess alongside the other track.

This, of course, liberates the old sleepers, which are carried out by a gang of about twelve men working in fours, each set of four, with the aid of dogs, lifting and carrying one sleeper. These are piled up alongside the old rails in the opposite cess ready for loading up into wagons as soon as opportunity permits, possibly the same day, but probably during the following week. A gang following then level the ballast ready for a seventh gang carrying in new sleepers. This is done in a similar fashion to the carrying out of the old ones, and when in, the new rails are picked up from the six-foot, where they have been lying since unloaded from trucks, and placed in position, or what is technically termed "chaired." The rails then require keying up, and fishplates placing and securing with bolts, but even then the work is not by any means completed.

First of all, the new road requires lifting and topping. This means that it must be made quite level so that trains will ride smoothly over it. In Fig. 4 the platelayers are seen lifting a place which is too low, by means of a lifting jack, the ganger watching the operation from a distance with his eye at rail level. He is instructing them when to cease lifting. The whole length relaid has to be gone through in this fashion.

Then the alignment of the rails must be attended to, and as the opposite road is perfectly in line, or should be, one end of

FIG. 3. CHAIRING RAILS.

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a six-foot gauge is placed on the inner rail of the road which is not being interfered with, and the new road pulled to the gauge with bars by the platelayers.

It will, of course, be understood that, when joining up the newly laid rails with the old road, full-length rails are not always suitable and have to be cut and drilled for fishbolts. These rails are called "Closures." To assist lucid explanation, the following list will show exactly how the hundred men referred to earlier are divided into gangs, and, further, it should be explained that when the first set of men have finished their work, which they will before the following gangs can complete theirs, they should be brought back to assist the rear gangs :—

4 men unscrewing old bolts.
6 ,, unkeying.
2 ,, turning old rails out.
12 ,, throwing out old rails and falling back to assist carrying out old sleepers.
12 ,, carrying out old sleepers.
4 ,, levelling ballast.
12 ,, carrying in new sleepers.
14 ,, turning in new rails, setting up and keying.
6 ,, fishing and screwing up.
6 ,, keying up.
12 ,, lifting and topping road.
10 ,, lining road.

Look-out men are also provided to warn the working gangs of the approach of trains, and so act as the eyes of the workmen.

One or two points of interest which are not, perhaps, always referred to in connection with relaying, are that in putting in a new road about $\frac{1}{4}$ in. spaces are left between the ends of each pair of rails to allow for expansion during hot weather, as otherwise the expanding metal would have to find an outlet somewhere, and possibly buckle. Small pieces of angle iron are temporarily placed between the rail ends to ensure the correct expansion spaces being given.

It should also be mentioned that special chairs with extended bases are used by many railway companies on either side of each joint to form a better foundation for the joint. In England it is the practice to place joints exactly opposite each other, but in some foreign countries this is not done, the joints being staggered, *i.e.*, placed other than opposite. Our American cousins appear to favour this practice, but probably this is accounted for by the fact that their road is made up quite differently, and the joints receive more support from the timbers, which are almost continuous on their road.

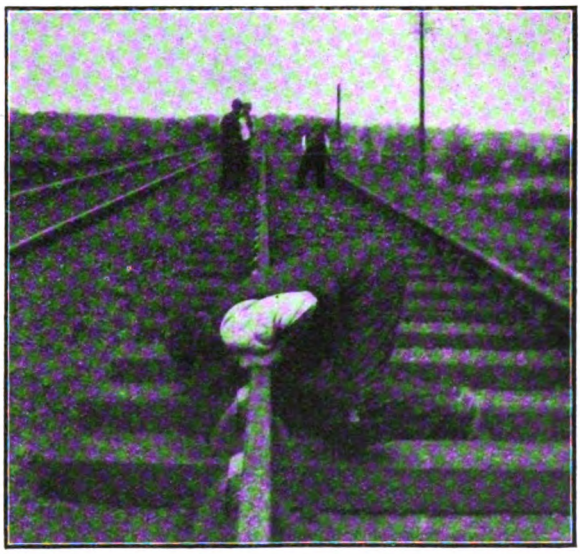

FIG. 4. LIFTING AND TOPPING.

In relaying curves, contrary to the general belief, straight rails are used, and pulled to the desired radius ; it is, however, necessary to use a number of short rails for the inside metal, and usually a number 4 in. less than the ordinary length are used. The outer rail is superelevated, the amount varying from $\frac{1}{2}$ in. to 5 in., according to the radius of the curve. When the road is joined up, trains are allowed to run over, but only at reduced speeds, and at caution, as the new material must be allowed to settle, and be re-topped and lined ; it must also be boxed, *i.e.*, ballast placed between the sleepers, and even then special attention must be paid to the new road by the maintenance gangs, who will probably have to lift many joints, and re-line in numerous places as the road beds. The limitations as regards speed are usually taken off at the end of ten days or a fortnight, when ordinary running is resumed.

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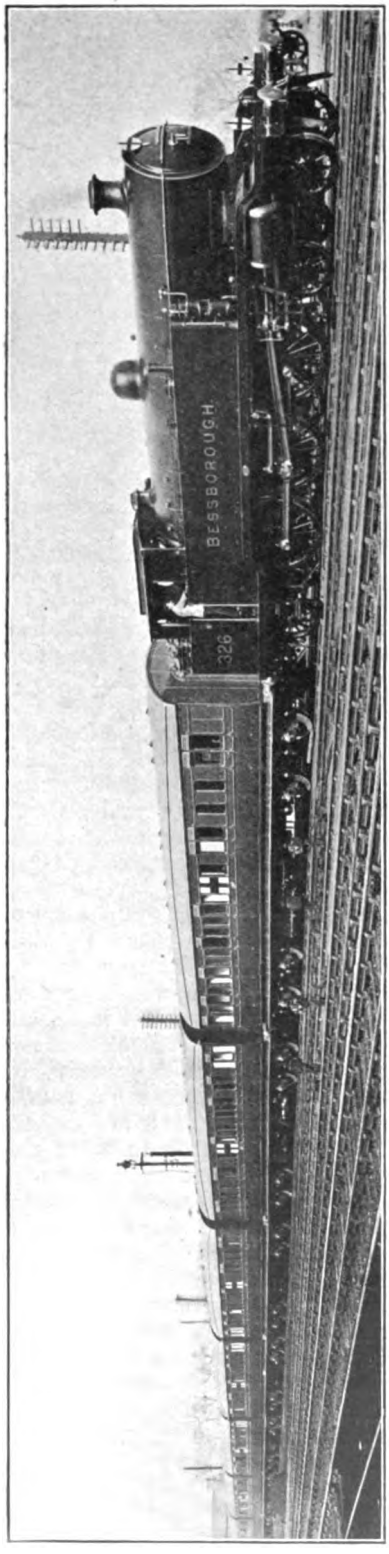

AMBULANCE TRAIN FOR CONTINENTAL SERVICE, PRESENTED BY LORD MICHELHAM.
Constructed at the Lancing Carriage Works of the London, Brighton and South Coast Railway.

Ambulance Trains for Continental Service.

IN previous numbers most of the ambulance trains equipped for service on the home railways have been described and illustrated; but in addition to these a number of ambulance vehicles have been sent out to the Continent for service much nearer the scene of active operations. Mention has already been made of the Great Eastern and London and North Western vehicles sent at an earlier date, but hospital sections for three ambulance trains may first be referred to. The cost of two of these has been defrayed by funds raised by the United Kingdom Flour Millers' Association, and the expense of the other section has been borne by Lord Michelham, a director of the Cambrain Railways.

The vehicles forming these hospital sections have been supplied by four English railway companies in accordance with arrangements made through the Railway Executive Committee, and they have been designed and fitted out with special regard to the care and comfort of the sick and wounded. Each hospital section is made up of ward cars, kitchen cars, and a pharmacy car, and in the case of one section a specially constructed living car, known as a "staff car," has also been provided for doctors and nurses.

The ward cars are fitted throughout with the Furley-Fieldhouse cots arranged in tiers of three, whereas most of the cars in use here have only two tiers of berths. The beds can be used as stretchers if necessary, and the cots are capable of being easily transformed into comfortable couches for sitting-up patients. Most of the ward cars have beds for thirty-six patients, whilst others have beds for thirty patients. All necessary sanitary and lavatory conveniences are provided in each car.

The kitchen cars are each provided with suitable heating and cooking ranges, which will admit of large quantities of hot water

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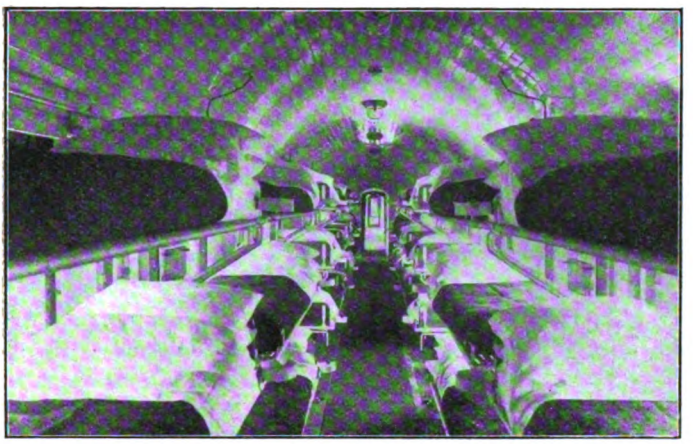


INTERIOR OF WARD CAR.

being available at any time. Food can also be cooked and quickly served up for patients, and there is a plentiful supply of cold water in each car. In addition, these cars contain a mess room for the personnel, and suitable accommodation for the cooks. All necessary fittings are provided for kitchen utensils, washing-up purposes, etc., as well as ample storage accommodation.

The pharmacy car contains a treatment room, equipped with operating table, etc., and a pharmacy compartment, with fittings for bottles and all necessary medical appliances, etc. A heater for water, of which there is a good supply is provided. This car also contains an office for the doctors and a store for linen, etc.

The staff car is for the doctors and nurses, and provides very comfortable living accommodation for day and night. The vehicles, which are of the most up-to-date pattern, are lighted throughout by electricity, and have also emergency lighting arrangements, and are heated on modern principles.

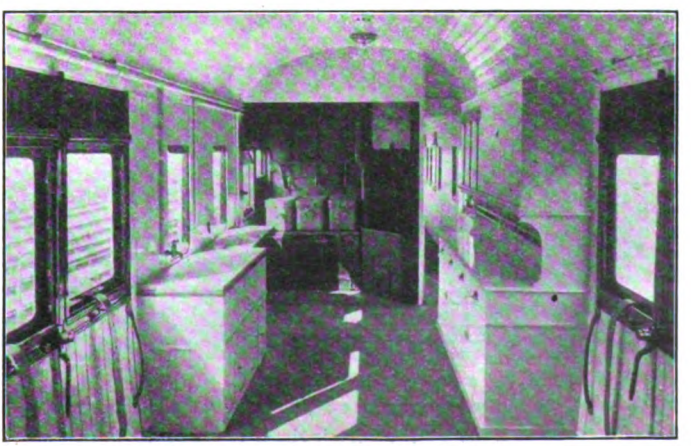
Illustrations are reproduced of the train presented by Lord Michelham. This was built at the Brighton Company's Carriage Works at Lancing under the supervision of Mr. A. H. Panter, Carriage and Wagon Superintendent.

On completion this was inspected by Her Majesty the Queen, accompanied by Princess Mary, at Victoria station, where they were received by the Earl of Bessborough and Lord Farquhar.

The train consists of seven bogie coaches, two kitchen cars, a pharmacy car and four ward cars, the exteriors of which are painted khaki colour with a large red cross on a white background painted in the centre on either side of each car. The four ward cars provide accommodation for 150 beds. The beds are fitted in tiers of three, and are of the Furley pattern supplied by Messrs. W. J. Fieldhouse, of Birmingham, and as the coaches have elliptical roofs, ample air space is given.

The kitchen cars are provided with a special army range, fitted with a circulating hot-water apparatus with a capacity of 50 gallons of hot water per hour, supplied by the London Warming and Ventilation Company. The water is supplied from two large roof tanks with a capacity of 150 gallons each, which enables an ample supply of hot and cold water to be available.

In the pharmacy car is a treatment room, an office and two linen rooms, equipment including an urn and sterilizers, so that if needed, an operation may be performed on the train. The fittings were supplied by Messrs. W. M. Still and Co., of London. Each coach measures 54 ft. long by 8 ft.



INTERIOR OF PHARMACY CAR.

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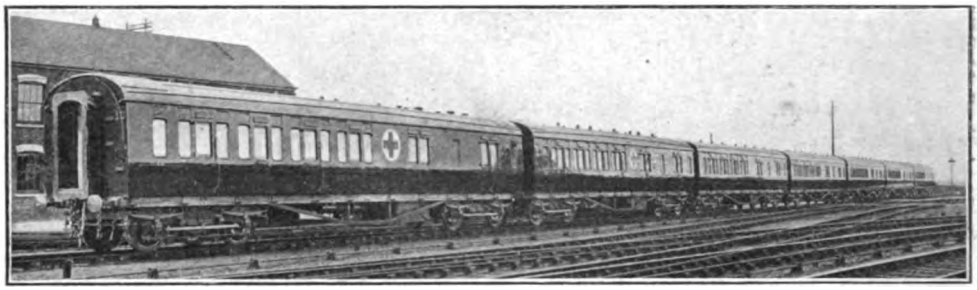


ONE OF THE TRAINS PRESENTED BY THE UNITED KINGDOM FLOUR MILLERS' ASSOCIATION.

6 in. wide and the whole train is steam heated and electrically lighted throughout.

Reference may also be made to the Princess Christian Hospital Train, built by the Birmingham Railway Carriage & Wagon Co. Towards the cost of this H.R.H. Princess Christian was instrumental in raising £25,000, and whereas most of the trains hitherto equipped have been provided by utilising and adapting rolling stock already in existence, this magnificent train has been specially built.

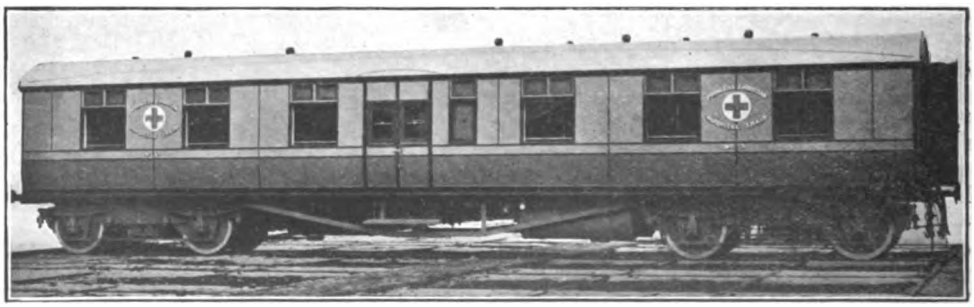
On April 13th Princess Christian inspected the train which bears her name at Paddington station, and the train was then sent at the command of the King to Windsor, in order that he and the Queen might also see this addition to railway hospital facilities.

There are 12 carriages, all fitted with Westinghouse brake, vapour system of steam heating, steel underframes and bogies. The carriages are lit by gas and electric light. The exterior is painted French grey, with mouldings picked out in brown and vermilion lines. Leading dimensions are as follows :—

	ft.	in.
Length over body	55	0
Width over body	8	9
Height inside at centre	7	8½
Length over buffers	58	6
Centres of bogies	39	6
Bogie wheel base	9	0
Diameter of wheels	3	7
Size of journals	8in. × 4in.	
Gauge of railway	4	8½
Total length of train	702	0
Weight of each carriage	29 tons	

Vehicles are allocated and equipped as follows :

(1) This carriage contains a compartment for the quartermaster, fitted with bed, writing desk, safe, bookcase, and lavatory; a large compartment provided with thirty beds of the Furley-Fieldhouse type; coal-burning stove; and lavatories. A large water-tank is fixed in the roof of the carriage; and cupboards for linen are provided at each end. There is also a tank for drinking-water and newspaper racks and



ONE OF THE CARS OF THE PRINCESS CHRISTIAN HOSPITAL TRAIN.
Built by the Birmingham Railway Carriage and Wagon Co., Ltd.

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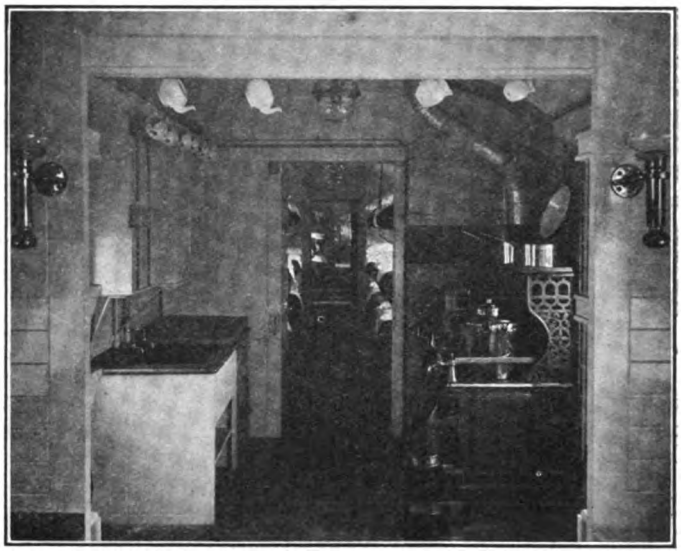
feeding-cup brackets. Emergency candle brackets are placed in convenient positions along each side of the coaches. All windows are fitted with spring blinds of green tapestry. The upper windows are hinged to open inwards for ventilation, and torpedo ventilators are placed on the roof for extracting foul air; the whole of the interior is enamelled white. A corridor in the centre is provided throughout the whole of the train, the carriages being connected by collapsible gangways.



KITCHEN IN NO. 4 CARRIAGE, PRINCESS CHRISTIAN HOSPITAL TRAIN.

(2) (3) (6) and (7) are similar to No. 1, excepting that provision is made for thirty-six beds in each, the quartermaster's compartment being omitted. No. 2 carriage is the gift of the Canadian Red Cross Society.

(4) This vehicle contains three compartments: one is provided with beds for twelve orderlies, with lavatory accommodation; the centre division includes kitchen and food stores, fitted with cupboards, refrigerator, plate rack, sinks are provided with hot and cold water, cooking stove, etc.; the end section is a linen stores fitted with cupboards, drawers, etc.

(5) This carriage is for the officers of the train. It is panelled in polished teak, and has a surgery, two dining-rooms, and sleeping accommodation for the chief officer, four doctors, and four nurses. The dining-room seats are arranged to draw out to form additional sleeping berths.

(8) In this carriage there are also three divisions. One is provided with beds for twelve orderlies, as in No. 4. The centre compartment is divided into racks for storing kits, etc. The end compartment is furnished as a kitchen, as in No. 4 carriage.

(9) (10) (11) and (12) These carriages are fitted with seats for sitting-up patients, and each carriage accommodates fifty persons. Lavatory compartments are provided at each end. Tanks for drinking-water, stoves, etc., are provided as in other parts of the train. The interior is finished in varnished pitch pine, the ceilings being painted white.

The work has been carried out in conjunction with Sir J. Furley and Mr. W. J. Fieldhouse, acting on behalf of the British Red Cross Society.

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Staff Changes on the Great Eastern Railway.

IN connection with a change of organisation, bringing that of the Great Eastern Railway substantially into line with several other leading railway companies, a number of officers are given new titles, and several important departmental alterations are made. These changes came into effect on Monday, April 12th, as follows:

Mr. Powis Lomas, Secretary, in addition to his other duties, now has control of the accounts, audit and funds offices, with the title of Secretary and Comptroller.

Mr. William Clacy May, Chief Traffic Manager, continues control of the goods and passenger departments, and also takes over the operating of the locomotives. His department is divided into two sections, "A" (operating) and "B" (commercial).

Mr. F. V. Russell becomes Superintendent of Operation, with charge of all matters relating to the movement of traffic.

MR. F. V. RUSSELL,
Superintendent of Operation, Great Eastern Railway.

Mr. T. W. Watts becomes Commercial Superintendent, and has charge of all matters relating to goods and passenger rates and fares, including season tickets.

Mr. A. J. Hill, formerly designated Locomotive Superintendent, assumes the title of Chief Mechanical Engineer.

Mr. H. Wilmer, formerly designated Engineer, assumes the title of Chief Civil Engineer.

Mr. S. A. Parnwell becomes Assistant to the General Manager, but retains his duties as Land Agent.

The position of District Goods Manager at Ipswich, rendered vacant through the appointment of Mr. Watts as Commercial Superintendent, has been filled by the appointment of Mr. P. Syder.

Portraits of Messrs. P. Lomas, Wm. C. May, A. J. Hill and H. Wilmer were given in the special Great Eastern Railway article published in the March RAILWAY MAGAZINE. Further portraits are now given, and the following particulars of the railway careers of the gentlemen mentioned will be of interest.

Mr. Lomas has been Secretary to the Company since January 1st, 1910, but he had been Assistant Secretary since 1907. He joined the Great Eastern Railway in 1879.

Mr. Wm. C. May, Chief Traffic Manager, entered the service of the Great Eastern

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Railway in the Rates Office of the Goods Department in January, 1886. In March, 1903, he was appointed Mineral Manager, afterwards being promoted to the position of Goods Manager in 1910. He became Chief Traffic Manager in December, 1914.

Mr. A. J. Hill, now Chief Mechanical Engineer, entered the Great Eastern service at Stratford in 1877, passed through a course of training in the workshops and drawing office of the Locomotive, Carriage and Wagon Department, and in 1882 obtained a Whitworth Scholarship. After acting for some years as Assistant Works Manager, he was in January, 1899, promoted to be Manager of the Locomotive, Carriage and Wagon Works, becoming Locomotive Superintendent in November, 1912. Mr. Hill is a member of the Institutions of Civil and Mechanical Engineers and President of the Institution of Locomotive Engineers.

Mr. Horace Wilmer, M.Inst. C.E., who recently succeeded Mr. Harry Jones as Chief Engineer, was educated at Rugby School. In 1871 he passed into the Indian Civil Engineering College, Coopers Hill, and was appointed in 1874 Assistant Engineer 2nd grade in the Indian Public Works Department. He was employed for two years under Col. Sankey, R.E., in works of irrigation in the province of Mysore, but for domestic reasons resigned his appointment in 1876 and returned to England. He entered the service of the Great Eastern Railway Company in May, 1877, and was employed as Resident Engineer on the construction of the Bishopsgate Goods depôt. In 1882 he was appointed Engineer of the Southern Division and has remained in charge of this division up to the present time. During that time he has carried out extensive works of construction and has had considerable experience of the maintenance of permanent way.

Mr. Fred. V. Russell, who now takes the title of Superintendent of Operation, was educated at Christ's Hospital for the executive of the Royal Navy, where his father and grandfather spent the best part of their lives, they having gained seven medals and the Legion of Honour between them. The knowledge of mathematics, navigation, and drawing attained at school proved very useful to him in the profession which he finally elected to adopt. He entered the service of the Great Eastern Railway as an apprentice to the Locomotive Superintendent in 1886, shortly after which he was summoned to Windsor Castle where Her Majesty Queen Victoria accepted one of his water colour sketches to place in the Royal Yacht *Osborne*, in recognition of which she graciously presented to him a gold pencil case engraved with her monogram. At the age of 19 he was fourteenth on the list of successful candidates in the examination for Whitworth Scholarships.

MR. T. W. WATTS,
Commercial Superintendent, Great Eastern Railway.

At the termination of his apprenticeship he joined the Works Manager's Department and spent a year or so in Scotland, Wales, and the North of England inspecting material for use in mechanical construction. In 1893 he was attached to the Drawing

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Office at Stratford, where he finally became Chief of the Locomotive designing section. He did a very considerable amount of design work for Mr. James Holden, including the "Decapod" and the "Claud Hamilton" engines, the latter engine being awarded a medal at the Paris International Exhibition in 1900. Whilst in the Drawing Office Mr. Russell spent a considerable amount of time during the winter evenings of six years in instructing a somewhat large class of over a hundred young men in engineering matters, under the supervision of the Board of Education. In his present appointment of Superintendent of Operation he will, under Mr. William C. May, the Chief Traffic Manager, have charge of all matters relating to the movements of the Company's traffic, which will include the operating, coaling, watering, oiling, cleaning, etc., of locomotives, carriages, wagons, and road motors, the compilation of time tables, train control, etc.

His staff will consist of cleaners, drivers, firemen, guards, signalmen and station and yard staff engaged in the manipulation of traffic.

Mr. T.W. Watts, now Commercial Superintendent, was educated at the March Grammar School, and entered the service of the Great Eastern Railway Company at the age of 15. After general training at various country stations, Mr. Watts became Cashier at Ipswich Goods station, and then Chief Clerk at Colchester. Thence he was transferred to the Goods Manager's General Office, until appointed Chief Clerk to the Ipswich District Goods Manager. Subsequently he was given charge of the Stratford Fruit and Vegetable Market and Goods Depôt, until promoted to be District Goods Manager at Ipswich. Mr. Watts has been a member of the Ipswich Municipal Corporation for nine years, is a member of the Ipswich Dock Commission, and a member of the Council of the Chamber of Commerce.

Mr. S. A. Parnwell, F.S.I., A.A.I., who now becomes Assistant to the General Manager, whilst retaining his duties as Land Agent, was born on January 4th, 1880. He was educated at the City of London School and the Huntingdon Grammar School. He entered the office of Messrs. Dilley, Son & Read, auctioneers, of Huntingdon, where he gained the experience of an agricultural auctioneering practice. He then came to London and was articled to Mr. Daniel Watney, of the firm of Daniel Watney & Sons, land agents and surveyors. During this period he passed the preliminary, intermediate, and final examinations of the Surveyors' Institution. Later he joined the staff of Mr. W. H. Elwell, Surveyor to the Great Northern Railway, and upon that gentleman's retirement, acted as assistant to Mr. A. J. Brickwell, subsequently becoming Chief Assistant. In January, 1909, when the office of Land Agent on the Great Eastern Railway, became vacant, Mr. Parnwell was appointed to fill the position.

MR. S. A. PARNWELL,
Assistant to the General Manager, and Land Agent, Great Eastern Railway.

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PERTINENT PARAGRAPHS

Uncertainty of Railway Arrangements under War Conditions.

THE fact that under present conditions our railways cannot announce with any certainty arrangements applying some time ahead, was strikingly indicated in connection with the Easter holidays. It was known some time ahead that there would not be the usual holiday arrangements, and references thereto published in our last issue were based on that assumption. During the days between closing for press and actual publication, even week-end fares were withdrawn, and the following official notice was issued on March 24th: "The Railway Executive Committee have been reluctantly compelled to cancel as from Monday next the issue, with a few exceptions, of all cheap bookings. The necessity for this step may be summed up under three headings: (1) the fact that the large works employed in the production of ammunition and ordnance will not be closed as usual during the Easter Holidays, and that the collieries are expected to be working nearly full time. As a result, the railway companies will have to run a full service of goods and mineral trains. (2) The large number of men who have left the railway service to join the Colours, the great majority of whom it has not been possible to replace without having a retarding effect upon recruiting. (3) The necessity for keeping a large number of men, engines, and vehicles constantly in readiness for Naval and Military purposes. Arrangements will be made after the holidays for issuing cheap tickets to enable families and relatives to visit men in camp at the various camp centres, and particulars of other cheap facilities which will be granted can be obtained upon application at the various railway stations."

Military Refreshment Rooms and Hostels at Railway Stations.

REFERENCE has already been made to provision at Victoria, Euston, Waverley and other large railway centres for supplying soldiers and sailors with refreshments and the like. Indeed, such facilities have now become more or less usual, including accommodation for free meals and light refreshments, as well as rest rooms and the like, according to requirements and the character of the military traffic using the station. Now, at Liverpool Street, Great Eastern Railway, the directors have placed at the service of Major Lennox a large well-lighted apartment in the centre of the station, with access from the well-known footbridge which crosses the station and near the Tea Room in the West Side portion of the terminus. The railway company provide crockery, and a good supply of newspapers and magazines is wanted. On the first day of opening, March 23rd, 400 men used the room, and in three days 2,000 men were provided with meals. All connected with the worthy enterprise are voluntary workers, and gifts of money and in kind for the soldiers and sailors are requested.

On March 25th, His Majesty the King, on his way to Harwich, visited the buffet, and was received by Major Lennox, who explained the objects and working of the organisation. When His Majesty entered the room it was crowded with soldiers and sailors. On hearing that several of the men had been in the recent fighting at Neuve Chapelle, King George evinced great interest. For some minutes he stood talking to them, and then went to the "business" end of the room and inspected the attractive dishes of food on the counter, after which he was conducted behind the counter. His Majesty expressed his great appreciation and delight at the arrangements, and thanked Major Lennox for what he had done. He also expressed his gratitude to the Great Eastern Railway authorities, who have provided and fitted up the room.

For the benefit of soldiers and sailors arriving at Liverpool Street station in the afternoon and evening and having to wait for a morning train at that or some other terminus, Major Lennox has established a hostel in Bishopsgate on premises adjoining Liverpool Street station lent by the Directors of the Great Eastern Railway, who also provide heating and lighting. Major Chauncey, chief constable of the Company, has charge of this hostel for Major Lennox, who has also arranged for similar accommodation at other termini where men can find a mattress and blankets provided by the War Office. A charge of 3d. for the night and for breakfast in the morning is made, but if a soldier or sailor has run out of funds no charge is made. Washing facilities are also provided, so that the men can start the day feeling fit. These organisations naturally require funds, and cheques, etc., will be gratefully received by the Soldiers' and Sailors' Hostels, c/o The London City and Midland Bank, 237, Tottenham Court Road.

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French Railways and the War.

An official review of the war from the French standpoint gives illuminating particulars of notable work done by the French railways, and a few notes in reference thereto will be of interest :—

The first great task was the transport of the "troupes de couverture"—that is, the troops sent to the frontier to meet the first shock of the enemy, and enable the mobilisation of the main armies to be carried out undisturbed—and then the mobilisation and concentration transports. The transport of the "troupes de couverture" began on July 31st, at 9 p.m., and was completed on August 3rd, at noon, without any delay either in the departure or arrival of trains, and before any of the ordinary train services had been suspended. The transport of troops, etc., in connection with the general mobilisation began on August 2nd.

On August 3rd and 4th nearly 600 trains were despatched on the Eastern system alone. The transports needed for the concentration of the armies began at midday on August 5th, and the first period, during which the most urgent transports were effected, ended on August 12th at the same hour. The second period of less urgent transports extended from 4 a.m. on August 12th to midnight on August 18th. During the first period, out of 2,500 trains despatched, about twenty were subjected to slight delays, which were made good in the second period. During the fourteen days nearly 4,500 trains were despatched, without counting 250 trains which carried siege supplies to the fortresses. These results were obtained in spite of the fact that the original destination of four army corps was changed after mobilisation had begun.

With regard to the ordinary transports, this was directed from "control stations" on the railways, and has worked with perfect regularity since the war began. During the retreat in August the control stations had to provide for all sorts of unforeseen needs, such as the removal of military and other stores, and often of the inhabitants from abandoned towns, and the withdrawal of French and Belgian rolling stock, in spite of which not a single supply train or troop train was ever stopped.

During the French offensive in Lorraine and Belgium in August, the retreat beyond the Marne, the subsequent advance, and again during the extension of our left to the North Sea, over seventy divisions were moved by railway from one point to another, the journeys varying from 60 to 360 miles, and necessitating the employment of over 6,000 trains.

The War and Transport Difficulties.

Criticisms of railways and the delays that occur in the conveyance of traffic appear from time to time, and it would almost seem that in some quarters there is an absence of appreciation that the railways are now in the hands of the State for the sole reason that the State traffic should have precedence of all other requirements. Commenting upon this some remarks recently published by our contemporary, the *Railway News*, may be quoted as follows :—

"We cannot for obvious reasons set out in detail what the railways are doing in conveying munitions of war and Government stores, but the fact that the work has, so far, been well done has been placed on record by the Prime Minister, Lord Kitchener, and other authorities. The extent of the Government business has been, and is, enormous, while superimposed upon it is an abnormal amount of certain classes of merchandise traffic. This is indicated by the fact that great quantities of freight which in ordinary times are conveyed by sea have been diverted to the railways in consequence of the high rates now charged for sea transit, or to the closing of ports. For example, coal for London and the south of England is passing in very great quantities. Indeed, we have been informed that the tonnage conveyed by one of the larger railways to places in the Metropolitan area during recent weeks has exceeded last year's totals by one-third. This is a noteworthy fact in the light of the outcry in coal circles as to the shortage of that commodity. Apropos of that feature of recent criticism, however, we observe that since the appointment of a Government Committee to investigate coal supplies less has been said of the alleged deficiencies of railway companies, and we should not be surprised if this were due to the fact that the Committee who visited certain railway coal depôts found the actual conditions very different from what had been represented to them.

"The fact is that there has been congestion in various quarters, and there will continue to be congestion, especially at junctions and exchange stations. In the months of December and January this was contributed to by floods and general unfavourable conditions of weather, with the result that there were accumulations of traffic. Then the southern lines were practically fully occupied by Government business, with the result that the other lines had goods "blocked back" for want of free exchange. The effect of such a state of affairs is obvious. 'Keep the traffic moving' is a railway axiom, and when on any line there is interruption of circulation delays are bound to occur. Added to this have been the difficulties incidental to withdrawal of many thousands of trained railwaymen for service with the Army and Navy, and the frequent inability of traders to promptly release railway wagons.

"As already announced by the Prime Minister and President of the Board of Trade, however, the Railway Executive Committee have tackled the problem with characteristic thoroughness and energy. A strong Committee has been set up, and we understand that satisfactory results have already accrued. Again and again traffic has been diverted from one line to another to avoid delay; one company has come to the assistance of another in regard to the supply of rolling stock and engine power, and in various

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ways steps have been taken to organise the railway resources of the country in such a way as, while continuing to give preference to Government requirements, to provide the promptest possible transit for civil traffic."

General User of Lines under War Conditions.

NOT only are railway wagons being "pooled," at least to the extent set forth in our last issue, and lines used almost irrespective of ownership, while our railways are being administered on behalf of the Government, but engines are being employed on runs which would not apply under normal conditions, working through from one system to another, and even performing duties on other railways for which they would never be utilised in the ordinary way. We understand that in some instances engines have been transferred to other lines to meet a demand for additional engine power. Recently a West Coast express from Edinburgh to London was worked through to King's Cross *viâ* the North British, North Eastern and Great Northern Railways, as a matter of traffic convenience; and no doubt a great many other special measures of a like character are taken as circumstances justify them.

The Roll of Honour which the Metropolitan Railway have placed in the main circulating area at Baker Street station, recording the names of 12 of the Metropolitan Railway Company's staff who, up to the present, have fallen in the country's service during the war.

Railway Engineering and the War.

How far-reaching are the effects of war conditions upon railway work can only be realised by those behind the scenes. There is, for instance, the difficulty of carrying out engineering operations affecting lines and stations. In the ordinary way Sunday is the special day for such work, as it is then practicable to obtain complete possession of one or more running lines by introducing single-line working, and the longer train intervals enable work to be done which is impossible on a weekday. Now, with special coal and goods trains for public requirements, and military and Government trains operated in large numbers on the first day of the week, the engineering departments are compelled to defer many operations arranged for, or to do only what is necessary, leaving the larger undertakings arranged for until a later date.

War Honours for Railway Men.

THREE Great Central Railway officers, attached to the marine section, have received war honours for distinguished service. They are: Captain H. B. Boothby, Outdoor Assistant to the Portmaster, Mr. C. V. Crossley and Captain W. G. Wood, all of whom hold Commissions in His Majesty's Navy. The official records from the *Gazette* are as follows:—

LIEUTENANT H. B. BOOTHBY, R.N.R., D.S.O. *Appointed a Companion of the Distinguished Service Order.*

When Trawler No. 99 (*Orianda*), in which he was serving, was blown up by a mine on the 19th December, Lieutenant Boothby successfully got all his crew (except one who was killed) into safety. Lieutenant Boothby was again blown up on 6th January, 1915, in Trawler No. 450 (*The Banyers*).

LIEUTENANT C. V. CROSSLEY, R.N.R., D.S.C. *Presented with the Distinguished Service Cross.*

Whilst sweeping on the 19th December, three violent explosions occurred close under the stern of his ship, Trawler No. 465 (*Star of Britain*). He controlled the crew, and himself crawled into a confined space near the screw shaft, discovered the damage, and temporarily stopped the leak sufficiently, to enable the pumps to keep the water down and save the ship.

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LIEUTENANT W. G. WOOD, R.N.R. *Specially Commended.*

Lieutenant Wood, Trawler *Restrive* (No. 48), did excellent work in going to the assistance of damaged trawlers on 19th December, and performed the risky duty of crossing the mine field at low water when sent to bring in the *Valiant*, which had been disabled by a mine.

Appreciation of "The Railway Magazine" by British Wounded.

FROM the War Library, Surrey House, Marble Arch, London, the Secretary writes :—"Among the sick and wounded there are many railway men and we like to provide, as far as possible, special literature for each profession, and they much appreciate THE RAILWAY MAGAZINE. Our stock is exhausted and the expenses of the Library are so heavy that the funds will not allow of many purchases. The publishers and public have been most generous, we cannot thank them enough ; but a constant supply of clean new magazines is needed, as the demands on the resources of the Library are enormous and increasing."

Women in Railway Operative Service.

THAT female labour would find its way into the operative side of railway work, as distinct from office and clerical duties, has been apparent for some time ; and a start has been made on the London and North Western Railway as regards their employment as booking clerks. Many arguments can be adduced against this policy, but as a general proposition it cannot be objected to, seeing that more or less similar duties are largely performed by women in other occupations. Duties which they have already commenced to take over include those of ticket collectors, porters, attendants on restaurant cars, clerks, etc. These are quite apart from such work as carriage cleaning, looking after bookstalls, and other occupations, where they should do as well as male employés. There have also been women stationmasters—at small and semi-private stations—while crossing gates are sometimes under feminine charge. It has been suggested that in many cases the wives or daughters of stationmasters or telegraph clerks might become assistants to their husbands or fathers, a practice which is, we believe, not altogether unknown at country stations, though not countenanced officially. At any rate, the suggestion is in accordance with the policy that "a woman who by working helps to relieve a man or to equip a man for fighting does national war service" ; and seeing that the Board of Trade is taking definite action towards the employment of women for suitable duties, notable extensions of this practice are to be expected in railway service.

Locomotive and Train Working in the Latter Part of the Nineteenth Century: London and North Western Railway.

MR. E. L. AHRONS writes in reference to his articles, of which the London and North Western section is concluded this month, as follows :—"On page 222 (March, 1915) I wrote with reference to the origin of the 5 ft. 6 in. 'Precursors' : 'It was stated at the time that the initial experiments consisted in the partial removal of the coupling rods of a 5 ft. 2 in. goods engine of the DX class, thus temporarily converting her from a six into a four-coupled engine.' The experiment in question was made some years before I could take interest in locomotive matters, and my authority was a statement that appeared many years ago in one of the technical papers."

"An old engine driver of the London and North Western Railway, Mr. Busby, has kindly written pointing out that the engine used was not a DX goods engine, but No. 961, a McConnell six-coupled engine with 5 ft. 6 in. wheels. I am glad to be able to clear up this point."

The Government and the Railways.

IT is announced that an alteration has been made in the agreement between His Majesty's Government and the railway companies whose undertakings have been taken over for the time being and administered by the Railway Executive Committee under the Regulation of the Forces Act, 1871. Under the original agreement the sum to be paid in compensation to the companies concerned was the sum by which the aggregate net receipts during the period for which the Government were in possession of the respective lines fell short of the aggregate net receipts for the corresponding period of 1913, subject, however, to a proportionate reduction if the net receipts of the companies for the first half of 1914 were less than the net receipts for the first half of 1913. It has now been agreed that this reduction shall not in future be made, but that 25 per cent. of the war bonus granted to railway employés who come within the railway conciliation scheme shall be borne by the railway companies, and not by the Government.

Third Class Pullmans.

HITHERTO, except for the fact that on the Caledonian Railway certain Pullman cars replace restaurant cars and are available for passengers of both classes for the purpose of obtaining meals and refreshments while travelling, these private-owned special vehicles have catered exclusively for first-class passengers. The question of providing corresponding special accommodation for third-class travellers has for some time been considered by the Pullman Car Co., Ltd., in conjunction with the London, Brighton and South Coast Railway, and we understand that several of the new cars are now under construction. It has been stated that they will be in service in the course of about two months, but whether that is so or not must depend upon the trend of events, the extent to which public railway travel can be catered for and encouraged during the summer months, and whether national demands upon our railways will become easier as time goes on. At first it

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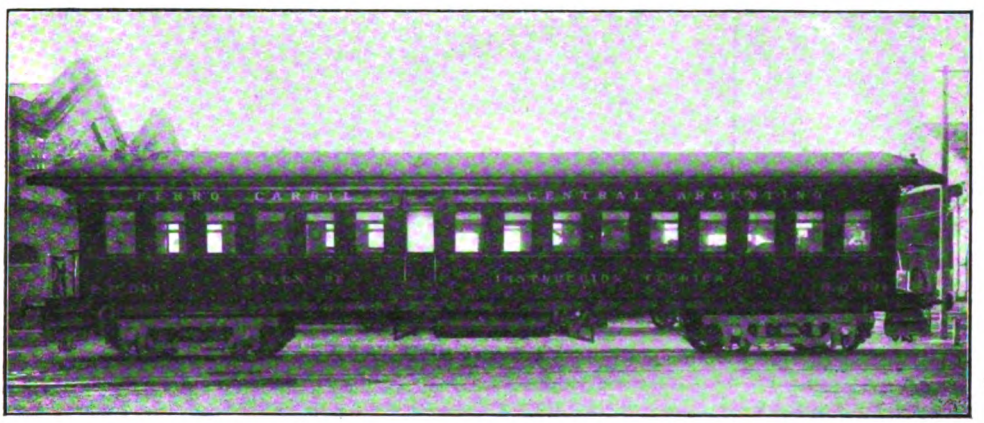
is intended to run the new cars between London and Brighton, with a supplementary charge of ninepence—not sixpence as stated in certain quarters—for the single journey, and there may be extensions to other services. Beyond the fact that this innovation is in contemplation little can be said at present; but when it is realised it will constitute a notable development in railway travel facilities, and one which should prove highly successful. It is understood that the cars will reach a high standard of equipment, though not quite to the level realised in the first-class vehicles; with tables and refreshment accommodation. Each car will seat 50 passengers.

Instruction Car: Central Argentine Railway.

Some time ago it was decided to inaugurate on the Central Argentine Railway a special car, purely for the instruction of locomotive men.



INSTRUCTION CAR: CENTRAL ARGENTINE RAILWAY.

This car, which has been designed and equipped by Mr. J. P. Crouch, Chief Mechanical Engineer, is sent on visits to various sections of the line, in charge of a competent locomotive inspector, with adequate sleeping accommodation, so that it is possible for him to be away from his home for a considerable period. At one end of the coach a collection of models is arranged on side tables. The centre part of the coach forms the lecture hall and is provided with seats. Drawings are arranged in racks and when they are in use are suspended from suitable fittings attached to the cross partition and hang in full view of the audience. The other end of the car next to the lecture hall is fitted up for the convenience of the Demonstrator and provided with a bed, shower bath, and the necessary furniture. There is a small library of suitable text books at the disposition of the staff.

The models, briefly enumerated and described, are :—

(1) Sectional semi-working model complete in every detail to a scale of one eighth full size, of the latest "Pacific" type of passenger locomotive, fitted with "Robinson" superheater, the sections being taken through the smoke box, boiler, firebox and cylinders.

(2) Model of Walschaert Valve Gear. This is a perfectly accurate working model made to a scale of one quarter full size, having the cylinder and piston valves sectioned, the crank circle being marked in degrees and the slide bar marked in inches of stroke, which enables the lecturer to readily explain by graphic charts the distribution of steam in the cylinder corresponding to the different notches on the reversing lever sector plate.

(3) Stephenson's Link Motion. There is also a working model of the above motion for demonstrating the complete functions of this gear in the manner above described under item 2.

(4) Cylinder Release and Bye Pass Valve.

(5) Steering Valve for Intercepting Valve.

(6) Regulator Valve.

(7) Safety Valve.

(8) Model of Superheater Header.

(9) Standard Fusible Plug.

(10) Wakefield Mechanical Lubricator.

(11) Detroit Sight Feed Lubricator.

(12) Wakefield Double Sight Feed Lubricators.

(13) Furness Cylinder Lubricator.

(14) Gresham & Craven's Injector and Combination Vacuum and Steam Brake Ejector.

(15) Vacuum Brake Equipment. This is a full sized working standard vacuum brake equipment for passenger stock, complete with brake cylinder, vacuum chamber, train pipe, end connections, conductor's valve, vacuum gauges and a hand vacuum pump, for giving practical demonstrations. There is also a vacuum ball valve and a diaphragm valve in section.

(16) Two Release Valves for Brake Cylinders.

(17) Model demonstrating the effect of gradients on the water in Locomotive Boilers. This model includes a frame supported at its centre of gravity in such a manner that it may be swung to various positions and secured in

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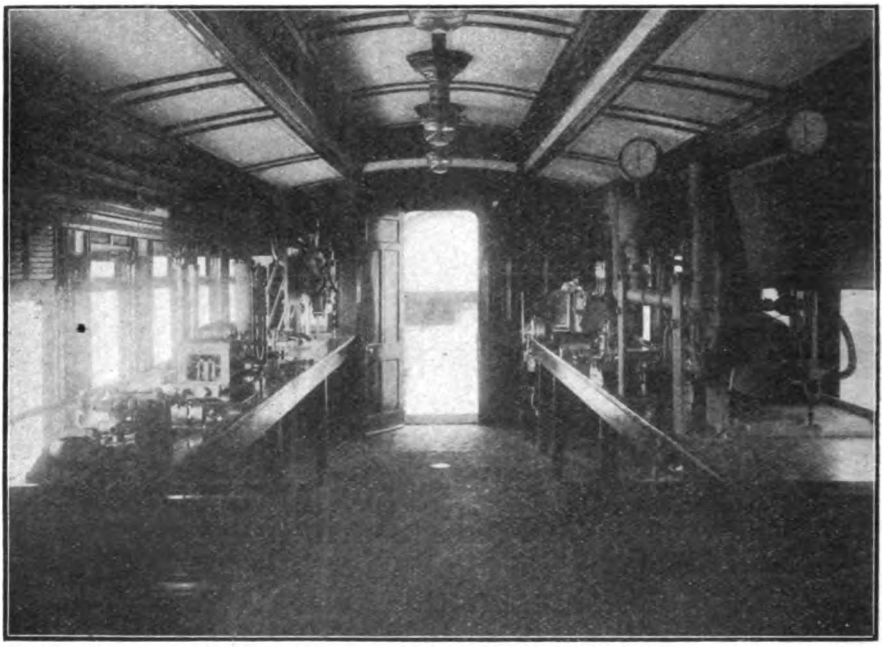
any desired position; this frame carries drawings showing the sections of locomotive boilers covering the principal classes on the system. Attached to the swinging frame is an indicator, the pointer of which traverses a scale showing the grade that a locomotive would be ascending when the model is adjusted at a certain angle. Across the front of the drawing of the boiler is stretched a wire which is level at all times, but which can be readily adjusted at any height above the crown sheet of the firebox. This model strikingly illustrates to the staff the effect grades have on the level of water in the boiler, and the amount of water which should show in the gauge so that the crown sheet of the firebox is never uncovered.

(18) Electric Train Lighting. Equipment has been added to exemplify the various details connected with train lighting, for instructing those employés whose duties have to do with the operation and maintenance of the coach lighting systems.

(19 & 20) Standard Axlebox Wagons.

(21) Internal Explosion Engine as used on a Rail Motor Car. This model is full sized, the working parts being in section, and when the crank is turned by a handle provided for that purpose, the action of the internal explosions may be readily followed. There is also a large collection of demonstration drawings, mounted and varnished, and coloured to represent the various metals of the different parts.



INTERIOR OF INSTRUCTION CAR: CENTRAL ARGENTINE RAILWAY.

Mercury in Locomotive Boilers.

A CANADIAN reader employed as an apprentice on the Grand Trunk Railway System, states that whilst working in the erecting shop, he noticed that in the scale taken from the boilers of locomotives stationed around Montreal, there were small quantities of mercury. This matter is outside our knowledge, and on placing it before the Kennicott Water Softener Co., they reply that "In all our experience we have never come across mercury in water. As you know we have a large number of plants installed in America, but this is quite outside our experience." It is to be presumed that our correspondent is in error in some way; but it would be interesting to hear the views of others, and so we invite correspondence on the subject.

Electric Automatic Locomotive Control.

ONE hears a great deal about special and more or less elaborate systems of locomotive control, and in view of references made recently to the installation of an electric automatic system of locomotive control, invented by Mr. A. J. Casale, on the Long Island Railroad, some further particulars now available may be given.

Two contact-making shoes are fastened to an iron bar on the forward part of the locomotive, one on each side. The shaft carrying these shoes is insulated from the locomotive frame. There are ten batteries, three solenoid coils and three relays. The first relay is operated in case of a break in the wiring or an obstruction on the track, such as a broken rail or a collapsed bridge. The second relay operates a small whistle in the cab, which warns the engine driver that the block ahead is occupied. The third relay stops the engine by directing a stream of air against one piston, which closes the throttle, thus

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shutting off the steam, and a second piston closes the emergency brake gradually.

The track apparatus on each block comprises two contact rails and wiring. The apparatus in the cab is manipulated when the shoes touch these rails and when the track is clear. The voltage in the track line is cut down by a 40-ohm resistance across the main rails. The wiring is carried on poles or in conduits. When the shoes first touch the contact rails the first solenoid is energised. This opens the circuit of the first relay, preventing it from stopping the train. When the shoes have mounted the contact rail two contacts on the shoes close. These contacts lead up into the cab to the first relay. If there is no trouble or danger the circuit remains open, as there is insufficient current to operate the relays, due to the resistance. If, on the other hand, the wiring should be broken or the circuit open in any other manner, such as damaged right of way, the circuit of the first relay is not opened by its solenoid, so that the closed contacts on the shoes complete an electric circuit which operates the first relay, and a valve in the air line is opened, admitting air into cylinders, equipped with the pistons, which close first the throttle and then the emergency brake.

The whistle in the cab is operated when a train is on the next block, because the resistance of the electric circuit is reduced on account of the current passing through the axle of the second locomotive instead of through the resistance. The third solenoid and relay operate when the two trains are near enough to cut out practically all resistance in the electric circuit. The solenoids are designed to operate at certain voltages—for instance, the first at 5 volts, the second at 10 volts, and the third at 15 volts. The voltage is dependent upon the resistance of the circuit, which grows less as two trains approach each other. When a train which should stop at a certain station runs by, it can be stopped by the stationmaster, who throws a small switch in his office, thus short-circuiting a set of contact rails placed at a certain distance beyond the station. In the event of a contact switch being open against a locomotive, the latter is stopped, because the opening of the switch is short-circuited by the contact rails placed at a certain distance in front of it. This system is said to work well in conjunction with the block system.

Railway Literature.

BRADSHAW'S RAILWAY MANUAL, SHAREHOLDERS' GUIDE AND OFFICIAL DIRECTORY, 1915. [Henry Blacklock & Co., Ltd. Price 12s.]. The new volume of this useful annual constitutes the 67th edition, and commences what is, in effect, a new series of volumes containing information based upon the new system of accounts issued by British railway companies under the Railway Accounts Act. The new form of accounts has necessitated a number of changes in the method of summarising them, and in many instances has made comparison with the figures of previous years impossible in detail. Among the special features associated with Bradshaw's Manual is the record of half-yearly figures of revenue and expenditure since the first railway company was incorporated, and this is retained in its original form. For 1913 the yearly figures are added, so that comparison can be made between the yearly total and the combined two half-year's of corresponding periods. Except for changes as above set forth all usual characteristics are retained. Among them may be specified the table of official changes and new appointments in the railway service. In respect of capital and financial aspects of railway working, Bradshaw's Manual occupies a unique position, and its value becomes more and more evident. This applies as much to foreign and Colonial railways, especially in regard to those where British capital is involved, as to the home railways, and in conjunction with its special features the 1915 volume is as useful as its predecessors, and in some respects more so.

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AN INDEX OF FIRST AID. By J. M. Carvell, M.R.C.S., L.S.A.Lond. [John Bale, Sons & Danielsson, Ltd., Oxford House, Great Titchfield Street, London. W. Price 1s. net.] This booklet is described as "A Vade-Mecum for the Ambulance Worker, and all interested in the subject of First Aid to the Injured." It is a useful publication, handy for the pocket, not the least valuable feature being the memoranda sheets provided in addition to the 130 pages or so of illustrated text.

* * *

MESSRS. JOHN BARTHOLOMEW & Co. (The Edinburgh Geographical Institute), send a copy of a new map of Egypt and the Lower Nile. This is produced in the publishers' well known style, and is sold at 2s. paper, or 3s. mounted on cloth. Messrs. Bartholomew have also issued a new and revised edition of their "Route Chart of the World." Price 1s. on paper, 1s. 6d. on cloth.

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FOR some time the Lower Edmonton-Cheshunt section of the Great Eastern Railway has been closed for passenger traffic, but commencing March 1st was again brought into use, the announcement suggesting, however, that this arrangement is of a temporary character. We understand that the additional traffic associated with Government and other establishments in the district making munitions of war is the main reason for this development.

For working this traffic the auto-train introduced first on the Cambridge-Mildenhall route is being used. This was illustrated and fully described in the January RAILWAY MAGAZINE. As first announced, with separate time-tables for other week-days and for Saturdays, the auto-train started from White Hart Lane at 6.20 a.m. for Cheshunt, and then made 15 trips each way between Cheshunt and Lower Edmonton, the last service from Cheshunt, at 10.5 p.m., being continued to White Hart Lane. The Saturday services differed owing to variations in connecting trains, and gave more facilities in the afternoon. Commencing March 20th the service was revised, the auto-train working exclusively between Lower Edmonton and Cheshunt, except that the first trips are now at 6.26 a.m. from Lower Edmonton to Forty Hill only, returning at 6.44 a.m. from the latter station, with 16 trips each way between Lower Edmonton and Cheshunt, with alterations on Saturdays, as previously in force. Tickets are issued on the train at very reasonable rates, first and third class, and workmen's fares are in operation.

* * *

A NUMBER of interesting engineering works have been completed or are in progress on the Caledonian Railway, under the direction of Mr. W. A. Paterson, Chief Engineer. Stirling station has been largely reconstructed. The station at Carstairs is being entirely rebuilt, and the work is already well forward. Aberdeen joint station reconstruction is almost completed. The stations at Port Glasgow, Carluke, and Laurencekirk have all been rebuilt and have been completed for some time. Considerable alterations have been carried out at Buchanan Street station, Glasgow, which have improved the accommodation very much. At Perth (General) station the old roofing covering the concourse and main down line platform, and part of the docks at the north and south ends, was entirely removed some time ago, and a new glass roof erected with verandah covering over the edge of the platforms. Considerable improvements have also been carried out at Alyth Junction station. An important piece of work will be carried out in the near future by the transference of the existing engine sheds at St. Rollox to new sheds which are being erected at Balornock Junction, a short distance north of St. Rollox.

* * *

AT the annual meeting of the Federation of British Health and Holiday Resorts, Sir R. Turnbull, late General Manager, London and North Western Railway, and Mr. A. Watson, Superintendent of the Line, Lancashire and Yorkshire Railway, made a confidential statement to the delegates as to the circumstances of State which had compelled the railway companies to curtail railway and excursion facilities. At a luncheon in connection therewith, Mr. H. W. Thornton, General Manager, Great Eastern Railway, replying to the toast of the railway companies, expressed the view that the War, terrible as it was, was going to result distinctly to the advantage of the health resorts. Certainly it was going to teach our people that the health resorts at home were just as good as those on the Continent, while from the American point of view it was going to bring more tourists to English spas and watering-places than ever before.

* * *

MR. ALFRED ASLETT, General Manager, Furness Railway, has issued an appeal, in which he recalls that the annual dinner of the Railway Benevolent Institution will be held at the Hotel Metropole, Whitehall Rooms, London, on Tuesday, May 4th, when the Rt. Hon. Lord Balfour of Burleigh, K.T., G.C.M.G., a Director of the Great Northern Railway Company, will preside Mr. Aslett adds: "I earnestly hope that this deserving Institution will not suffer a diminution of income in consequence of the special funds being raised to alleviate distress arising out of the War, especially as, in addition to having met, and continuing to meet, all demands for transportation of troops and material, the railway service has 67,000 men of all grades serving with the forces, which will involve this Charity in increased liabilities, and, therefore, I invite your very liberal consideration of this appeal. The interests of the railways and traders, as you are aware, are closely identified, and I earnestly appeal to your sympathy and generous support on behalf of an Institution which has greatly benefited so many employés in the railway service and those dependent upon them."

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MANCHESTER "PALS" DETRAINING AT HEATON PARK STATION (LANCASHIRE AND YORKSHIRE RAILWAY), MANCHESTER, FOR REVIEW BY LORD KITCHENER.

Photo] [*E. Hulton & Co., Ltd.*

THE Directors of the Caledonian Railway have appointed Mr. David Lindsay Forgan to be their Solicitor. After a general legal training, Mr. Forgan qualified as a solicitor in 1890. He entered the service of the Caledonian Railway Company in the Solicitor's office in October, 1892, and has since acted as an assistant, and been closely in touch with the legal matters affecting the commercial side of the Company. For a number of years he occupied the post of lecturer on the commercial law of railways, and on the law relating to the construction of railways and public undertakings, in the Glasgow Athenæum Commercial College. He was appointed interim solicitor in September last, on the retiral of Mr. Hugh Reid Buchanan.

* * *

MR. CHARLES A. HARRISON, D.Sc., who retired from the position of Chief Engineer of the Northern Division of the North Eastern Railway, in December last, was recently the recipient of a handsome present from the members of his staff at the Engineers' Office, Forth Banks, Newcastle. Mr. John Hope, chief assistant, made the presentation, which took the form of a set of eight solid silver candlesticks in a velvet lined Morocco leather case. He spoke of the honour and respect which Mr. Harrison had

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won from all grades of the service, and remarked that it had always been a source of pleasure to them to see Mr. Harrison's success and note his world-wide reputation. They had many monuments of his engineering skill, the chief of which was the King Edward Bridge. Mr. R. Ker (engineer's accountant) spoke of the improvements which had taken place on the railway during Mr. Harrison's régime. There was the substitution of steel rails for iron rails, the substitution of steel for cast-iron girders in bridges, and the new power signalling. The King Edward Bridge at Newcastle and Queen Alexandra Bridge at Sunderland would endure as lasting monuments to Mr. Harrison's skill as an engineer. Mr. Harrison, in reply, said it was 48 years since he went into the engineer's office; and, looking back, one was rather proud to see what one had done. But there were still in England—in the north-eastern portion of it—big jobs to be done. It was only a question of money, and they could be done. First of all, there was the tunnel through the Carter Fell which would make a considerable increase of line; and there was the other one, which would make a connecting link through the hills, from Grassington to Darlington.

* * *

FURTHER changes in the official staff of the Cardiff Railway Company (Bute Docks) are announced. Mr. E. A. Hart, Chief Accountant, retires after service of over fifty years, and is succeeded by his principal assistant, Mr. J. C. Dore. Mr. Hart entered the employ of the trustees of the Marquis of Bute in the year 1855, and was first connected with the accountant's department of the Bute Docks in 1864. Mr. Hart was appointed chief accountant on the death of Mr. Collingdon in 1885, and thus has spent over fifty years in that one department. Mr. J. C. Dore, who succeeds Mr. Hart as chief accountant, has spent the whole of his business life in the service of Lord Bute and the Company. He entered this employ as a boy from school thirty-five years ago, served in the staithe-master's and the collector's departments successively, and for a long period has been principal assistant to Mr. Hart in the accountant's department.

* * *

THE Great Eastern Railway Musical Society, so successfully conducted by Mr. W. J. Galloway, has suffered severely owing to the War; many of its members have joined the Colours, and are now serving under the flag in widely distant parts. The Symphony and Choral Concerts which the Society has been in the habit of giving, have had to be abandoned, but among those members whose duties in the service of the Great Eastern Railway Company require them to remain at home a smaller choir and orchestra have been formed for the purpose of giving concerts at camps and other military centres. One of these concerts was given in the Y.M.C.A. Hall at the White City on March 16th, when the Society had the assistance of Miss Annie Bartle, Mr. Ben Davies (who very kindly gave his services) and Mr. Walter Barker. Another concert was given on March 23rd at the Stratford Town Hall to the newly-formed West Ham Battalion, and on March 25th at the Crystal Palace, where Mr. Ben Davies again kindly consented to sing. Many of the performers are engaged in strenuous day-time work, but they feel that they are more than compensated for devoting their spare moments to this concert work by the hearty and truly British enthusiasm with which their efforts have been appreciated.

* * *

THE twenty-first annual competition for the North British Railway Ambulance Challenge Cup took place in the Trades' Hall, Glasgow, on April 10th, 1915. The competition, which was conducted under the auspices of the St. Andrew's Ambulance Association, consisted of a practical demonstration of treating the injured, and of the transport of the injured, as well as an oral examination. Ten minutes were allowed for examination in each of the three departments. The examiners were Drs. Wishart and Kenmure Melville, Edinburgh, and Dr. Halliday, Glasgow. The competition was open to teams of five men from any station on the Company's system, and the following twelve teams took part:—Cowlairs station, Dunbar, Dunbar District, Helensburgh, Kinross Junction, Leith Central, Leith District, Montrose, Queen Street station, Tay Bridge, Thornton and Waverley station. Arrangements in connection with the competition were carried through by Mr. Ferguson, of the St. Andrew's Ambulance Association, and Mr. Murray, of the General Manager's Office, North British Railway. The cup is held by the winning team for a year, and each of the members receives a gold medal. Amongst those present were the following:—Sir John Stirling Maxwell, Bart., and Mr. McCosh, Directors; Mr. Andrew, Chief Goods Manager; Mr. Black, Superintendent of the Line; and Mr. Reid, Locomotive Superintendent. The result of the competition, which was intimated by Mr. Andrew, was as follows:—The team from Waverley station won the cup; that from Helensburgh took second place; the team from Leith District was third, and Thornton took fourth place.

* * *

THE death of Mr. Matthew Waddell, late Chief Goods Manager of the Caledonian Railway, occurred on March 12th. Mr. Waddell, who retired in May, 1913, had seen many years of railway service, commencing in the office of the Goods Manager of the Glasgow and South Western Company, and later served the Glasgow and Paisley Joint Railway, where he gained experience in various departments. In February, 1867, he joined the Caledonian Company under the late Sir James Thompson, who was then Goods Manager. He afterwards served as Chief Assistant to the late Mr. Hillhouse, General Goods Manager, and succeeded to that position on Mr. Hillhouse's retirement eight years ago.

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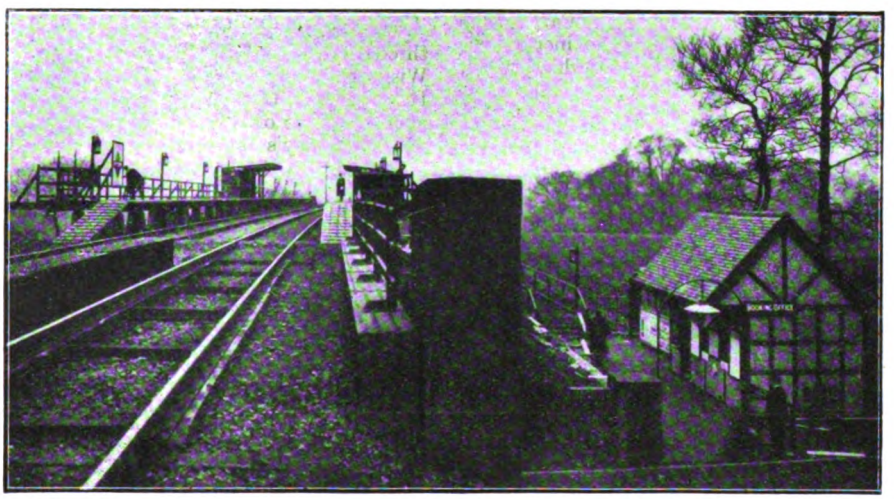
LIEUT.-COL. VON DONOP'S report in reference to the disastrous accident at Ilford on January 1st this year is consolatory in that it shows that all the normal safeguards—interlocking, signalling instruments, lock-and-block, and emergency detonator-placers—justified themselves, and the blame is confined entirely to the driver of the Clacton express. The Inspector points out that the only witness who alleges that any of the signals (applying to the express) were not in the danger position is Driver Bloomfield, who states, with regard to the Ilford East signal-box distant signal, that he "took it to be in the off position." He, therefore, expresses his opinion as follows: "There can be no doubt, however, that he was mistaken, and that that signal, as well as the others, was at danger. That distant signal was at a distance of 650 yards from the East signal-box home signal, so had Bloomfield realised that it was at danger he would have had no difficulty in stopping his train at the home signal. It was to this undoubted mistake on the part of Driver Bloomfield, in not noticing that the distant signal of the East signal-box was at danger, that this collision was primarily due. But, even after making this mistake, Bloomfield should have seen the position of the East signal-box up home signal in ample time to have prevented the collision."

* * *

REFERENCE was made last month to the opening of a new station, to be known as North Harrow, between Harrow and Pinner, on the Metropolitan and Great Central Joint line. A view of the station is reproduced above. It is served by a number of trains belonging to both the owning companies, in the one case giving rapid communication with Marylebone station and the London "tube" railway system, and in the other with Baker Street and the City lines and connections of the Metropolitan Railway. Harrow, as a favourite and rapidly growing residential district, now has two stations served by Metropolitan and Great Central trains (Harrow-on-the-Hill and North Harrow), and one by Metropolitan trains only (West Harrow), while other parts are served by the District South Harrow station and by the London and North Western main line Harrow and Wealdstone station.

* * *

MR. A. F. BOUND'S paper, entitled "A Review of the Art of Signalling, and Some Suggestions," created a lengthy discussion at the adjourned meeting of the Institution of Railway Signal Engineers on March 24th. The speakers were: Mr. W. C. Acfield, Signal Engineer, Midland Railway; Mr. P. Lomas, London and North Western Railway; Mr. A. Oldham, Assistant Signal Superintendent, London and North Western Railway; Mr. P. Whysall, Signal Engineer, Metropolitan District Railway; Mr. R. J. Insell, Signal Engineer, Great Western Railway; Mr. Ellison, Telegraph Superintendent, North Eastern Railway; Mr. H. W. Firth, Electrical Engineer, Great Eastern Railway; and Mr. E. C. Irving (British Pneumatic Railway Signal Co., Ltd.). A feature of the discussion was the emphasis laid upon what "lock-and-block" has already done, the general tendency being towards the conclusion that while "lock-and-block" has its weaknesses as well as its virtues, the same may be said of track-circuiting, and therefore it is better to use what is good in each and develop from either or both as appears desirable, rather than to anticipate progress purely in one direction and the supersession of the other.



NORTH HARROW STATION: METROPOLITAN AND GREAT CENTRAL JOINT RAILWAY.

* * *

AT a meeting of the Railway Club on Thursday, March 25th, Mr. W. J. Thorrowgood (London and South Western Railway) gave an interesting address on "The Art of Railway

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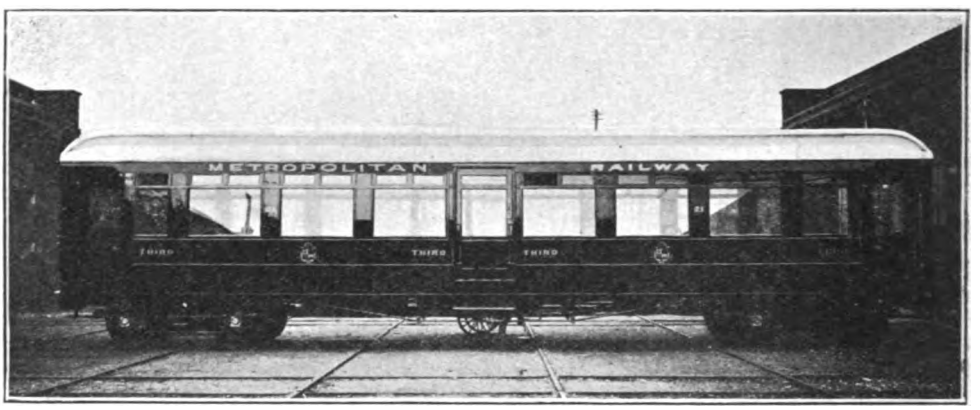
Signalling," illustrated with a number of drawings and diagrams and a collection of photographic views, ancient and modern. There was a good attendance, and that the address was highly appreciated was shown by the discussion which followed. On Tuesday, April 13th, Mr. E. J. Miller, Hon. Secretary, read a paper on "Characteristics of Swiss Railways," illustrated with lantern views, and this was quite up to his usual standard of comprehensiveness and interest. At the May meeting, to be held on Tuesday, the 11th, Mr. G. W. J. Potter will read a paper on "Some Early Railway Maps." In addition to names already recorded on the Railway Club "Roll of Honour," the following members have joined His Majesty's Army:—H. W. Bardsley (3rd Battn. Scots Guards); Rev. H. E. Hubbard (Chaplain at Havre). Captain J. L.G. Burnett, 2nd Battn. Gordon Highlanders, has been awarded the D.S.O., while the Committee announce with regret that Private Ffitch of the 3rd Battn. Scots Guards has been "reported missing."

* * *

ONE of the London and North Western 4–6–0 ("Experiment") passenger engines, No. 1361, *Prospero*, has been converted to a four-cylinder engine, and is now running. It is provided with Schmidt superheater and piston valves and Joy's motion, the cylinders being 14 in. in diameter. Other features include a slightly larger boiler and extended smokebox. No. 513 *Precursor* has recently been provided with Schmidt piston valves and an extended smokebox, thereby making it uniform with the rest of the type that have been superheated. It will be remembered that the above engine was originally converted with flat valves. As thus altered the engine was illustrated recently in these pages.

* * *

THE Great Eastern Railway locomotive and carriage works at Stratford, and the wagon shops at Temple Mills, about a mile away, occupy an area of over 130 acres. About three years ago a much needed-improvement was effected by the erection of a new block of buildings on the west side at Stratford, which embraced a modern iron foundry, the site of the old foundry being devoted to other purposes. Further improvements are now in hand on the same side but more to the north, beyond the locomotive running depôt. Here, at a spot known as High Meads, a carriage paint shop is in course of construction, and a commencement has been made with the erection of a new engine repairing shop. Two bays of the former are completed, but ultimately the shop and stores will consist of four bays, each 42 ft. wide, the whole covering an area of nearly 74,000 sq. ft. The repair shop will comprise three bays, each 50 ft. wide and 480 ft. long. The centre bay will be used as serving shops and stores, whilst the side bays will be equipped with the usual engine pits and benches, and served by overhead travelling cranes of 40 tons capacity.



REMODELLED THIRD CLASS CAR FOR USE ON THE GREAT NORTHERN AND CITY "TUBE" SECTION OF THE METROPOLITAN RAILWAY.

* * *

COMMENCING March 29th the train service on the Great Northern and City section of the Metropolitan Railway, between Finsbury Park and Moorgate Street, was considerably improved, a service being arranged for two trains every 4½ min., thus making practically a two-minute service. Continuing the policy of developing facilities and accommodation on the Great Northern and City "tube" section, the Metropolitan Railway have rebuilt and modernised several of the cars in accordance with their own standards, and an illustration is here reproduced showing one of the reconstructed vehicles as now running.

* * *

IN connection with the widening of the line between Finchley Road and Wembley Park, to provide for the running of an increased and accelerated service between City stations and

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MR. PERCY SYDER,
Ipswich District Goods Manager, Great Eastern Railway.

other country stations, the Metropolitan Railway have entirely reconstructed their station at Finchley Road, and in conjunction with this work two entrances to the station have been provided, one in Finchley Road and the other in Canfield Gardens. In addition several commodious shops have been built and the whole surmounted by roomy and well appointed flats of the most modern type.

* * *

REFERENCE is made on another page, in referring to reorganisation and new staff appointments on the Great Eastern Railway, to the fact that Mr. Percy Syder has been made District Goods Manager at Ipswich, in place of Mr. T. W. Watts, who takes the new appointment of Commercial Superintendent of the Chief Traffic Manager's Department. We have pleasure in reproducing a portrait of Mr. Syder. He was born at Fakenham in 1879 and educated at Norwich Commercial School. He entered Great Eastern Railway service in the Goods Manager's rates office in March, 1896, being subsequently appointed South Country canvasser in July, 1900, London Coal Exchange representative in April, 1903, chief traffic canvasser in July, 1911, and chief commercial agent in June, 1913. The latter duties include the supervision of Great Eastern Agencies in the North, Midlands, and Scotland; Agricultural Shows, and Corn, Wool and Coal Exchanges. His new appointment took effect as from April 12th, 1915.

* * *

MR. F. G. SMITH'S new 4–6–0 locomotives for the Highland Railway, now under construction by Messrs. Hawthorn, Leslie & Co., Ltd., will constitute a considerable advance upon the "Castle" engines, which have hitherto performed the hardest main line duties. There will be six of these engines, Nos. 70–75, and they are being fitted with Robinson superheater, Ross safety valves, Belpaire firebox and Mr. Smith's feed-water heating apparatus. Cylinders are outside, 21 in. by 28 in.; coupled wheels, 6 ft. diam.; heating surface: firebox, 139.6 sq. ft., 2 in. tubes, 997 sq. ft., 5 in. tubes, 463 sq. ft., superheater 348 sq. ft., and grate area, 25.3 sq. ft.

* * *

MR. REGINALD CORY, son of the late Mr. John Cory, has been elected a Director of the Barry Railway Company in place of the late Mr. Richard Cory.

* * *

WITH the April issue the *South Western Gazette* after an unbroken run of 35 years, appears as No. 1 of the *South Western Railway Magazine*. In its new form our new contemporary will compare favourably with corresponding publications issued by other railways; but is still unique in that it has a special insurance value as regards members of the railway staff. A special feature is that matters of staff interest constitute its principal contents, with a few general items of London and South Western interest.

* * *

To the lengthy list of railways which have fitted engines with the Weir equipment for feed-water heating is now added the Great Eastern, one of their six-coupled standard goods and mineral engines, No. 1240, having been provided with the Weir locomotive feed pump and heater. The heater is fitted on top of the boiler, giving the engine a peculiar appearance.

* * *

IN the RAILWAY MAGAZINE for September, 1909, Vol. XXV., page 247, reference was made to the fact that No. 2225, a Great Western tank engine of the 4–4–0 type, had been painted a light shade of crimson lake as an experiment. Subsequently a large number of the small tank engines of the 0–4–2 and 0–6–0 types—the former of the side-tank and the latter of the saddle-tank pattern—have been painted crimson, but a darker shade. Officially this crimson colour has been described as "brown," to match the colour of the motor trains which these engines work, but actually the two tints are quite distinct. Now a further change has been introduced, and one of the small 0–6–0 engines, originally a saddle-tank, rebuilt with "pannier" side tanks, has been painted a genuine brown, very similar to that adopted on the London, Brighton and South Coast Railway.

AN attractive pamphlet, issued by the Grand Trunk and Grand Trunk Pacific Railways, directs attention to the facilities offered for visiting the Californian Expositions at San Francisco and San Diego. It is everywhere expected that a great many tourists, not only from Eastern Canada and the United States,

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but from Great Britain also, will visit these Exhibitions this year and make use of the Grand Trunk Pacific route, which enables them, besides visiting the most picturesque portions of the Canadian Rockies and the Beautiful Steamship Route from Prince Rupert to Seattle (through the Canadian Fjords), of acquainting themselves with the new agricultural and commercial areas this latest transcontinental has opened up.

* * *

MR. E. J. CHAMBERLIN, President of the Grand Trunk System, presided recently at the first annual meeting of the Grand Trunk centre of the St. John Ambulance Association. Mr. Chamberlin has taken a keen interest in the organization of first aid classes in the railway shops and terminals and he expressed himself as being gratified at the progress made during the first twelve months of active work. Plans were made to still further extend the system of first aid instruction, which Mr. W. D. Robb, Superintendent of Motive Power, declared was proving of distinct value in the big plants of the Company, where many men were employed. The Company pays the salary and expenses of a general organizer to conduct classes and there are now twenty-six of these classes at various points on the railway, with 779 students enrolled. Examinations are held at intervals and certificates, medallions, etc., presented. In the first general competition for all railway ambulance teams in Canada, one from the Grand Trunk won the Wallace Nesbit Challenge Trophy.

* * *

AN American contemporary states that the mileage of railroad in the United States operated under the block system on January 1st, 1915, was 88,128 miles, this being an approximate increase of 943 miles as compared with the previous year. The more significant total, however, is that of automatic block signal mileage, 29,689 miles of road, as compared with less than 27,000 reported a year ago. The increase of something over 3,000 miles of automatic signalling compares with 3,827 miles increase in 1913. The year 1914 makes a better showing than was to have been expected. The 1913 increase was very large, compared with years before that. Now, as in former years, the smaller increase in the grand total is explained by the fact that a large mileage of automatic signals was installed to take the place of the manual or telegraph block system.

* * *

COMMENCING March 23rd, the Paris, Lyons and Mediterranean Railway (whose system covers nearly the fourth part of the total area of France), by arrangement with the military authorities, further improved the time-tables of most of their long-distance trains. Among the announced improvements, the following are of particular interest to British passengers: The night express between Paris and Marseilles and the Riviera, which during the past few months has been running *viâ* Nevers and St.-Germain-des-Fossés (Bourbonnais), has become a "rapide," and has resumed its normal route *viâ* Laroche, Dijon (Bourgogne), with an accelerated time-table, gaining two hours between Paris and Lyons and three hours on the whole journey. Sleeping accommodation is available right through; also a restaurant car between Avignon and Nice. Through carriages in connection with this service are run to the Nimes-Montpellier-Cette district. A new night express (with carriages for three classes, and *lits-salons*, couchettes, and sleeping-car berths) now runs between Paris and Lyons, *viâ* Dijon, leaving Paris at 8.55 p.m. and Lyons at 9.35 p.m. Extensions of this service run to Geneva, and to Grenoble, Modane, Turin, Rome. The journey between Paris and Lyons by the day express service already in existence (with carriages for three classes and a restaurant car all the way) has been shortened by two hours.

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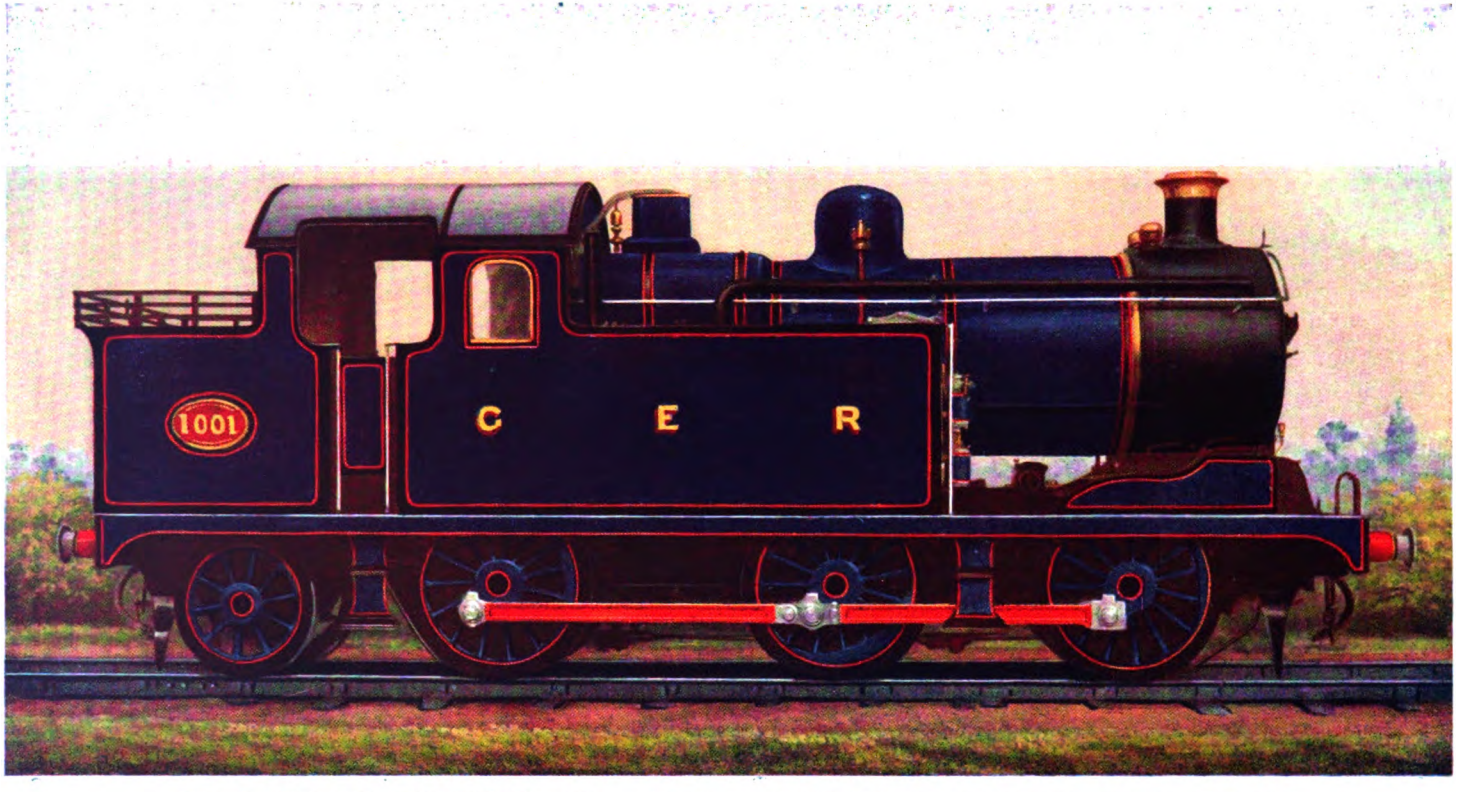

0-6-2 TANK ENGINE, No. 1001: GREAT EASTERN RAILWAY.

Designed by Mr. A. J. Hill, Chief Mechanical Engineer.

Cylinders, 18 in. by 24 in.; coupled wheels, 4 ft. 10 in. diam.; steam pressure, 180 lbs. per sq. in.; grate area, 17·7 sq. ft.; heating surface, 1,394 sq. ft.; weight in working order, 61 tons 12 cwt.

Fitted with inside Walschaert valve gear, Robinson superheater, "top-feed" and mechanical lubricator.

Published by "THE RAILWAY MAGAZINE."

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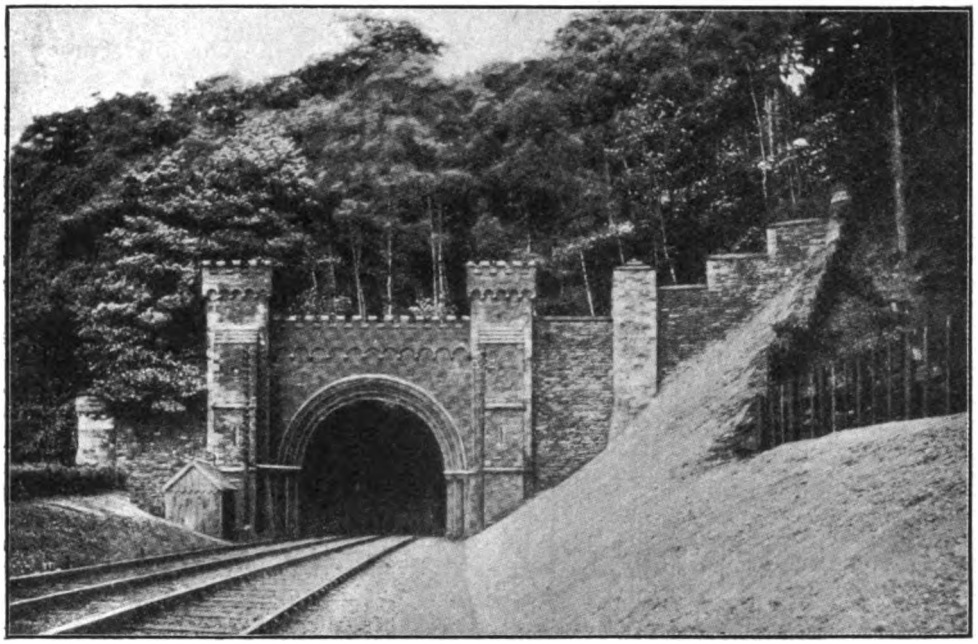

Photo] [*L.N.W.R.*

ONE OF THE PORTALS OF SHUGBOROUGH PARK TUNNEL.

The Railways of South Staffordshire. [No. I.]

LONDON & NORTH WESTERN RAILWAY LINES.

By PHILIP F. GROVES.

INCLUDING one of the most important industrial areas of England the South Staffordshire district is provided with an exceedingly complex and complete system of railways, though the fact that they pass into Warwickshire simultaneously with their entry into the city of Birmingham confines the scope of this article to lines to the north thereof. While, however, the railway geography of the district permits of this delimitation being observed, the fact that so many of the lines to be considered extend into other parts of Staffordshire necessitates attention being given to certain sections which hardly justify the title adopted for this article. It is not intended, however, to deal with the whole of the railway system of the county, so that it will be sufficiently accurate to adhere to the title selected, with the understanding that when lines as far north as Stafford and Burton-on-Trent receive attention, it is because they require consideration in order to deal adequately with the South Staffordshire lines.

As thus liberally interpreted, the area under review is served by five railways, London and North Western, Midland, Great Western, Great Northern and North Staffordshire. For convenience it will be best to deal with these railways separately, and as it possesses the longest mileage in the county, the London and North Western Railway will receive first attention.

As the apex towards which so many lines are directed we may commence at Stafford and follow the Trent Valley main line south as Tamworth, before diverging to the complicated Wolverhampton, Walsall and Birmingham areas. Stations concerned are Lichfield (Trent Valley, Low Level), Armitage, Rugeley (Trent Valley), Colwich, Milford and Brocton. At Lichfield there is a high-level station at right-angles to and immediately over the low-level station, the former being situated on a branch from Birmingham, Walsall, and Lichfield City to Burton and Derby, which line will be further dealt with later on. As at Rugeley, the Trent Valley station at Lichfield is some way from

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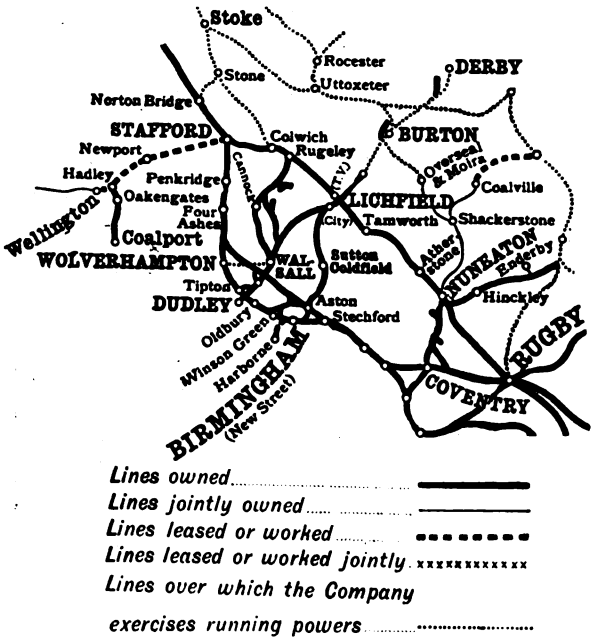

MAP SHOWING LONDON & NORTH WESTERN RAILWAY LINES IN THE BIRMINGHAM, WOLVERHAMPTON AND STAFFORD DISTRICTS.

the town (or City, in Lichfield's case), each place having a City or Town station on a branch line, which at Rugeley runs through the heart of Cannock Chase, the well known and, in places, beautiful colliery district between Walsall and Rugeley.

Colwich is the junction for the North Staffordshire branch to Stone and Stoke, which, like the London and North Western main line, passes through part of the beautiful Shugborough Park. On the latter route there is a tunnel in the park, in a singularly picturesque situation, while the former line is in the open. From Tamworth to Stafford is double track, though through the junction stations there are four lines. It is interesting to note that for some distance between Milford and Stafford stations, and in two places, northbound trains travel in a south-westerly direction.

Stafford is the junction for two important lines, besides those of the Great Northern and North Staffordshire companies. One of these, which includes the parent line of the original London and Birmingham Railway, passes through Wolverhampton, Birmingham and Coventry to Rugby, and the other through Wellington (Salop) and Shrewsbury to Welshpool, where traffic for the Cambrian Railway is handed over to that company's charge. The Wolverhampton, Birmingham, and Coventry line forms an alternative route to the London and North Western main line between Rugby and Stafford, but with two exceptions (12.5 a.m. and 12.15 *ex*-Euston) no trains use this line as such. Several goods and mineral trains, however, travel between Rugby and Stafford by this route, as will be explained later.

The Stafford, Shrewsbury, and Welshpool branch takes all the London and North Western traffic from Stafford and south thereof to the watering places of Central Wales and to Welshpool and the Cambrian Railway (Aberystwyth, etc.). At Wellington trains for the Welsh lines join the direct route of Great Western trains from London *viâ* Birmingham and Wolverhampton, both the London and North Western and the Great Western Companies operating through trains or carriages to the Cambrian system, over the Wellington-Shrewsbury section. A considerable traffic is carried on over the Stafford-Shrewsbury route to the four Welsh "Wells" or "Spas"—Llandrindod, Llangammarch, Llanwrtyd, and Builth. Haughton and Gnosall are the only stations on

Photo [*Felix E. Jones.*

LONDON AND NORTH WESTERN EXPRESS RUNNING THROUGH LICHFIELD (T.V.) STATION.
4-4-0 locomotive No. 1509 *America*.

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this line situated in Staffordshire. Haughton has six trains from and seven to Stafford, and Gnosall seven from and nine to the county town.

On the Birmingham line, Penkridge, Gailey and Four Ashes are the intermediate stations between Stafford and Wolverhampton. These stations are respectively 5¾, 8, and 9¼ miles distant from Stafford, and Wolverhampton 15 miles. Between these towns there are about 21 trains each way daily, 10 or so being non-stop. An important coal-mine—Littleton Colliery—has siding connection with this line near Penkridge.

Wolverhampton, an important manufacturing county borough with some 95,000 inhabitants, is served by two stations. The High Level station is used by the London Winson Green, and Monument Lane. There are about 39 trains daily in each direction between Birmingham and Wolverhampton by this route, several of these not running on Saturdays. Five are non-stops, and eighteen call at Dudley Port only. The prevailing gradient on this section is 1 in 100, but gradients of 1 in 94 and 77 (this for the last mile descending through the North Tunnel into Birmingham, New Street station) also occur, the line having a tendency to fall towards New Street.

Besides the trains mentioned, there are several others which travel over only part of the line, and these, together with an exceedingly heavy goods and mineral traffic, combine to make this one of the busiest, and probably *the* busiest, section of line in the

Photo] [*Felix E. Jones.*

LONDON AND NORTH WESTERN EXPRESS TRAIN PASSING LICHFIELD (T.V.) STATION.

and North Western and Midland trains but belongs to the former, the Great Western owning and using the Low Level station close to, but somewhat obscured by its neighbour, which, owing to its higher level, tends to overshadow it, though both are imposing stations. From Wolverhampton to Birmingham there are four London and North Western routes, one Great Western and one Midland, making six in all, of which five are used by passenger trains.

Starting from Wolverhampton the stations served by North Western trains *viâ* Dudley Port are Monmore Green, Ettingshall Road, Deepfields and Coseley, Tipton Junction, Dudley Port (High Level) Junction, Albion, Oldbury, Spon Lane, Smethwick, Soho, district. The country between Wolverhampton and the Midland metropolis is purely industrial, the chief industries being coal-mining, all kinds of metal work (from pins to stationary engines) and the manufacture of fire-bricks and crucibles, and, in the south western corner of the county (near Stourbridge) of chains.

Dudley Port is the junction for a branch, 1½ miles long, running to Dudley a thriving town of some 40,000 inhabitants, situated in a detached portion of Worcestershire entirely surrounded by the county of Stafford. Here is the residence of Sir Gilbert Claughton, the chairman of the London and North Western Railway Company, who has been mayor of the town. There are fifty-five

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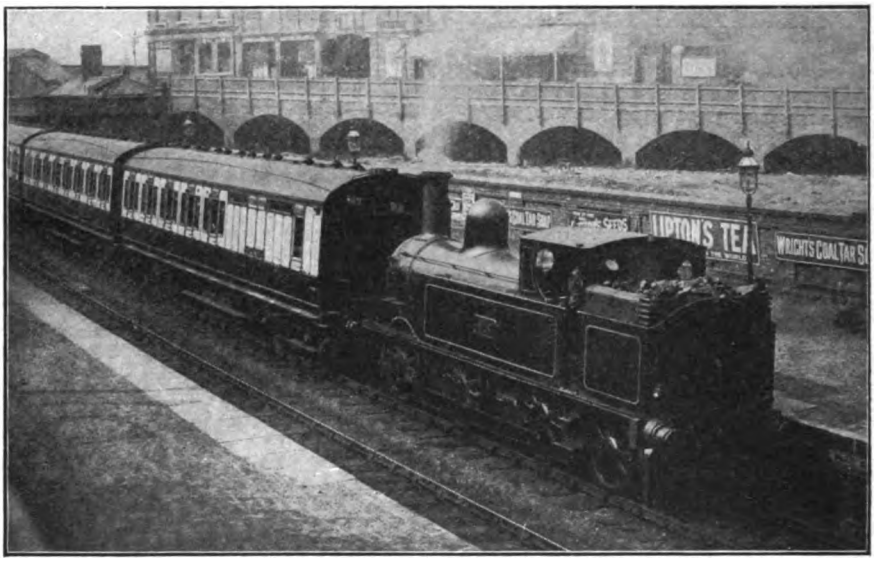
passenger trains over this branch daily, connecting at Dudley Port with trains to and from Birmingham and Wolverhampton, a few trains to the former city being through. Most of the trips on this branch are worked by 2–4–0 and 2–4–2 tank locomotives with two or more bogie coaches fitted to work as motor trains, as used in many other districts.

There is a low-level station at Dudley Port, directly under the high-level one. The former is on a branch which runs from Walsall to Dudley, and the trains on this line (fourteen each way) bring the total number of trains up to 69 each way daily. Connection between this branch and that from Dudley to Dudley Port (High Level) is at Sedgley Junction.

Another connection between the Walsall and Dudley branch and the Wolverhampton-Dudley Port (High Level)-Birmingham line is effected by the Princes End branch, which leaves the main line between Deepfields and Tipton stations, with two junctions, facing towards both Birmingham and Wolverhampton, known as Tipton and Bloomfield Junctions respectively.

It joins the Walsall and Dudley branch at Wednesbury station, one of the three stations between those towns. There are two stations on the Princes End branch—Ocker Hill and Princes End—and also various sidings. The length of the branch from Tipton or Bloomfield Junctions to Wednesbury is 2 miles 20 chains. From Bloomfield Junction to mile-post 1½ there is a continuous ascent at 1 in 94 and 75, and for the remaining 110 chains the line falls towards Wednesbury at 1 in 77 and 85.

Passenger train service on this branch is very small, four motor trips to Wednesbury and three in the opposite direction daily comprising the total service. All these trains run over the Wolverhampton and Birmingham main line between Tipton Junction and Dudley Port, at which place all these trips commence or terminate, as the case may be. Regular passenger trains do not use the spur between Princes End and Bloomfield Junction, though many of the goods trains which daily traverse the branch in each direction use it to travel from Wolverhampton to Walsall, etc., *viâ* Princes End and Wednesbury. Princes End has goods accommodation, which is not provided at Ocker Hill.



Photo] [*Felix E. Jones.*

0–6–2 TANK ENGINE AT SMETHWICK STATION, LONDON AND NORTH WESTERN RAILWAY.

Returning to the main Wolverhampton and Birmingham line at Dudley Port, after passing Albion, Oldbury, and Spon Lane stations a branch line is seen curving sharply towards the main line on its (up) south-west side. This connects the Great Western Birmingham and Stourbridge line, under which the London and North Western Railway passes a few chains north of the junction, with the latter line. Connection with this branch is made by the Great Western Railway

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at Smethwick Junction station, and by the London and North Western Railway at Galton Junction. The branch is used only for the transfer of London and North Western through coaches between Birmingham (New Street) and Kidderminster, Tenbury, and Woofferton on the Great Western and London and North Western joint line between Shrewsbury and Hereford. A London and North Western engine takes them from New Street to Smethwick Junction, where they are attached to Great Western trains from Snow Hill. These coaches form separate trains as far as Smethwick Junction, and leave New Street at 8.51 a.m. and 4.22 p.m., arriving at Kidderminster at 10.9 and 5.29 respectively, and at Woofferton at 11.30 and 6.50 (Tenbury 15 min. earlier). The route followed by these trains is *viâ* Stourbridge Junction, where they run on to the Oxford, Worcester, and Wolverhampton section of the Great Western Railway, leaving it again at Kidderminster for a branch running across the Severn and through the Wyre Forest to Cleobury Mortimer (junction for the interesting little Cleobury Mortimer and Ditton Priors Light Railway), Tenbury and Woofferton. Tenbury is, by the way, becoming known as an inland "spa," and is now known as "Tenbury Wells." A corresponding service runs daily from Woofferton, etc., to New Street station.

A single line branch, 2½ miles long, and situated wholly in the City of Birmingham, joins the main line from Wolverhampton between Winson Green and Monument Lane stations on the down side, at Harborne Junction. Here the four lines which exist between Winson Green Junction and this point merge into two. This branch comes from Harborne, a pleasant suburb of Birmingham, passing through Edgbaston, a large and fashionable district. The stations are Hagley Road, Rotton Park Road, Icknield Port Road, and Monument Lane, the branch joining the Wolverhampton line between the two latter stations.

The Harborne Railway is worked for a company (which usually pays a dividend of 1½ per cent.) by the London and North Western Railway. It was opened on August 10th, 1874. There are, however, no less than twenty-six trains from and twenty-seven to the city daily, and one extra from Harborne to Monument Lane and back. Some of the trains do not run on Saturdays, and there is no Sunday service. From Harborne Junction the line ascends steeply over a canal bridge and under a road bridge, beyond which the gradient moderates slightly to 1 in 66, continuing at this inclination through Icknield Port Road, a very small single-platform station in a cutting, to Rotton Park Road, 75 chains from Harborne Junction.

At Rotton Park Road station there is a passing loop, surrounding the single island platform. Immediately beyond some sidings are seen, and from these a branch descends on a steep gradient to Messrs. Mitchell and Butler's famous breweries, about ¾-mile away. This branch, which has a very sharp curve about half-way down, and which also possesses a catch siding on the steep gradient, is of much more recent construction than the Harborne branch, having been opened during 1909. Messrs. Mitchell and Butler have a private locomotive named "John Barleycorn" for working the branch, there being notices at the junction prohibiting London and North Western engines from running on this line. Three goods trains (two on Saturdays) leave the brewery daily, and two arrive. The Harborne branch is in a cutting all the way from the Harborne Junction to 15 chains beyond Hagley Road station (135 chains in all), except for about 5 chains at Rotton Park Road.

Beyond Hagley Road station, to which place from Rotton Park Road the line is fairly level, the line begins to descend towards Harborne at 1 in 66, reaching the latter station in 2 miles 30 chains from Harborne Junction. Hagley Road station has two goods sidings, and Harborne six or seven, the latter station having also a goods shed and a turn table. At Rotton Park Road there is a ground frame, the other stations have no signals. The branch, being single line, is worked by the electric staff system, with Monument Lane, Rotton Park Road, and Harborne as staff stations.

It is now necessary to deal with other London and North Western routes between Wolverhampton and Birmingham. That *viâ* Bescot Junction and Aston Junction leaves the Dudley Port route immediately south of Wolverhampton station. From here to Heath Town station (closed in 1911), about 45 chains, London and North Western trains run over Midland metals, but at the junction the two companies' lines separate, the Midland to Walsall and Birmingham diverging on the north side. At Portobello Junction, a few chains east of Heath Town Junction a direct line from Bushbury joins the line under consideration, enabling goods and

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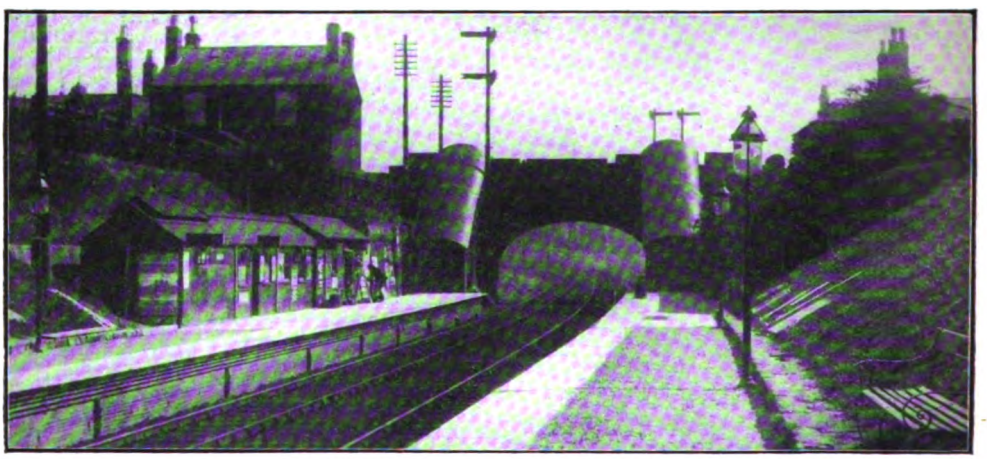
mineral trains not having traffic for Wolverhampton to run through from north of Bushbury to south of Wolverhampton without passing through the already congested station at that place. Only two regular passenger trains use this line, as all others call at Wolverhampton. These are the through expresses from Manchester to Bournemouth *viâ* Birmingham, Gloucester, Bath and the Somerset and Dorset Joint Railway, and the corresponding trains in the opposite direction. One is booked to leave Manchester at 10 a.m., arriving at Birmingham at 11.53 a.m. and Bournemouth West at 4.53 p.m. The train in the reverse direction leaves Bournemouth West at 9.40 a.m., arriving Birmingham at 2.10 and Manchester at 4.2 p.m. Coaches from Manchester to Bournemouth run over the Midland Railway from Birmingham to Bath, where the Somerset and Dorset Joint Railway takes them over.

Returning to Portobello Junction, and proceeding eastwards, Willenhall station is reached, 90 chains from Portobello and 150 chains from Wolverhampton. Thence the line passes Darlaston and Wood Green stations and under the Walsall and Dudley branch before reaching Bescot station. Darlaston is the junction for a branch 2⅛ miles long which runs direct to Walsall, though this town may also be reached from Wolverhampton by the Midland Railway and by travelling *viâ* Wood Green to Bescot and changing there on to a branch 1¾ miles long which runs from that place to Walsall. Wood Green is a somewhat unimportant station, with nine up and ten down trains, but Willenhall and Darlaston stations have about three times this number.

Bescot Junction is 6¼ miles from Wolverhampton, and there is a locomotive depôt (London and North Western Railway No. 6) adjoining the station, at which depôt numerous 0–6–0 goods and coal engines are stationed for working the very heavy goods and mineral traffic of the district. A few passenger 2–4–2 tank engines are also kept here, also several 0–6–2 tank locomotives, while 0–8–0 goods and mineral engines are usually to be seen in the large marshalling and sorting sidings which adjoin the station.

Newton Road and Great Barr stations come next after Bescot, the former being unprovided with goods accommodation, but the sidings and colliery of the Hamstead Coal Company adjoin Great Barr station, which also has some goods sidings of its own. Between Bescot and Newton Road station the line passes beneath a very high aqueduct carrying a canal, which is carried at this point over a valley by means of a high embankment.



PERRY BARR STATION, LOOKING EAST.

Perry Barr, the next station, is within the Birmingham city boundaries, and suffers from tramway and motor omnibus competition. Between Great Barr and Perry Barr stations there is a triangular junction on the down side, giving connection with the Wolverhampton and Birmingham direct line between Soho and Winson Green stations. Some of the trains from Walsall and Wolverhampton to Birmingham *viâ* Bescot proceed onwards from Great Barr over this line, passing on to the Dudley Port and Birmingham line at Winson Green, but others

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continue on through Perry Barr, in which case the next station reached is Witton, beyond which is Aston Junction, 13 miles from Wolverhampton and 8½ from Walsall. The branch from Sutton Coldfield and Lichfield joins the Walsall and Birmingham line here, and there is also a line to Stechford, on the Birmingham, Coventry and Rugby main line.

A large locomotive shed and depôt is situated in the fork between the Stechford and Birmingham lines, the other London and North Western locomotive depôt in Birmingham, which is, however, considerably smaller, being at Monument Lane (No. 10). From Aston there is a branch to Aston Goods Depôt and to the Corporation Gas Works. At Vauxhall, a mile beyond Aston, is a large carriage depôt, but that at Monument Lane is the principal one. New Street station is entered at its east end (generally termed the South End), 15½ miles from Wolverhampton by the Bescot route, the line having described a complete semicircle round the city between Witton and New Street. Similarly the west end of the station, where the direct trains from Wolverhampton and Dudley Port enter, is referred to as the North End.

Between Great Barr and Winson Green there are two stations, Handsworth Wood and Soho Road. Except for a short tunnel near the former station, the line is entirely in a cutting except at its Winson Green end. In consequence of the triangular junctions at each termination, four distinct train services are carried on over this line, between:

1. Great Barr and Winson Green and Birmingham.
2. Perry Barr and Winson Green and Birmingham.
3. Great Barr and Soho and the Dudley Port line.
4. Perry Barr and Soho and the Dudley Port line.

Only journeys Nos. 1 and 2 are performed by ordinary passenger trains, many trains between Walsall and Birmingham *viâ* Bescot using the former as an alternative to running *viâ* Aston. A circle service is in operation between Birmingham (New Street), Soho Road and Birmingham (New Street), *viâ* Aston, Soho Road and Winson Green. Not many trains perform the complete circular journey, but several do so except for the last mile or so, in order to enable them to end their journeys at one of the carriage depôts at either Monument Lane or Vauxhall. Many trains from and to Walsall and Wolverhampton also call at Handsworth Wood and Soho Road, giving a total service to Birmingham from these two stations *viâ* Monument Lane of 13 trains daily, and 15 in the reverse direction. From Birmingham to Handsworth Wood and Soho Road *viâ* Vauxhall there are five trains daily, some requiring a change at Vauxhall, whilst in the reverse direction there are nine trains from both stations, the services being less on Saturdays. Handsworth Wood station serves an extensive and somewhat picturesque residential district.

(To be continued.)

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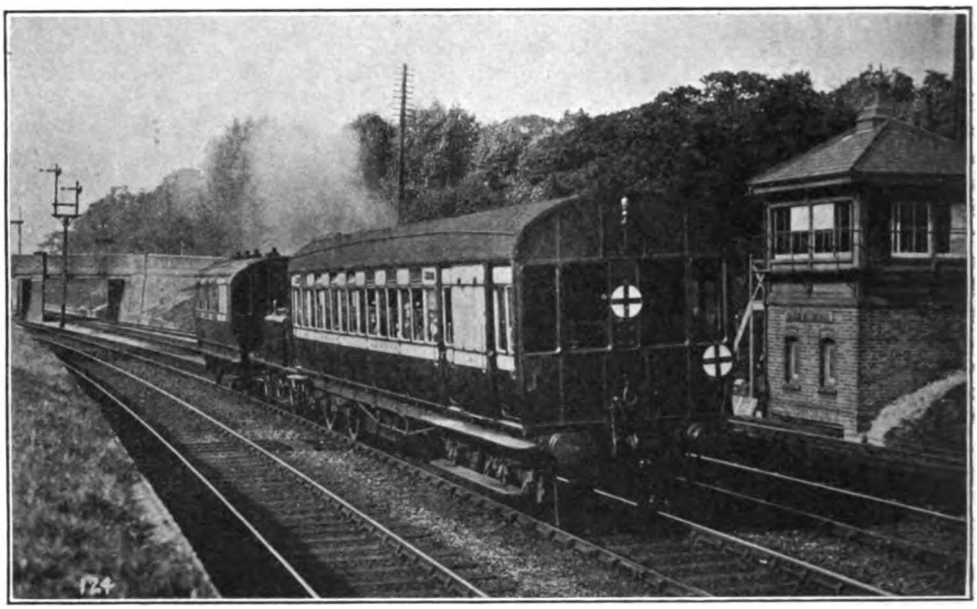

Photo] [*F. E. Mackay.*

MOTOR TRAIN (VICTORIA-SUTTON SERVICE): LONDON, BRIGHTON AND SOUTH COAST RAILWAY.

Auto-Trains [No. II.].

By "VOYAGEUR."

CONTINUING reference to lines where existing rolling stock has been utilised for auto-train make-up, this policy is seen on a number of London and North Western services, particularly those which are worked between ordinary stations only, where tickets are issued and collected. In most instances these are suburban services serving populous districts, so that the cars are run in "units" of two, marshalled on one side of the engine, a pair of "units"—two vehicles on either side of the engine—being used when the requirements of traffic render increased accommodation necessary. One such "unit" consists of two cars, the first of which contains driving and luggage compartment, three first-class compartments and four third-class compartments, while the second contains eight third-class compartments, the pair thus having seating accommodation for 32 first, and 120 third-class passengers. Another "unit" is made up of two coaches, one containing the driver's and luggage compartment and six third-class compartments, and the other four first-class and three third-class compartments, seating in all 32 first and 90 third-class passengers. In both instances the driving coach has been converted from an 8-compartment 50 ft. bogie coach; in the first-mentioned, only one compartment was used for driving and luggage, while in the second case, accommodation for more luggage being required, two were utilized for this purpose. The other coach in the second instance is an ordinary first and third-class composite coach. A third type of vehicle, also converted from an 8-compartment third-class bogie coach, contains driving and luggage compartment (two original compartments employed), two first-class and six third-class compartments, accommodating 16 and 60 passengers respectively. These vehicles are used mostly on country branch services, and work either singly or in pairs, in the latter instance being both generally marshalled on one side of the engine. The whole of the foregoing vehicles are 50 ft. long, and average in weight 25 tons each.

On the Great Eastern Railway a curious conversion has taken place. In this instance two semi-corridor main line bogie coaches have been employed (with internal corridors leading only to the lavatories in the centre of each coach); the lavatory partitions have

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been removed, thus making these corridors continuous, and each pair of coaches is vestibuled together, to allow of the issue of tickets *en route*. The vehicles employed are a 48 ft. composite coach, seating 9 first-class and 30 third-class passengers, and having a small luggage compartment adjacent to the engine, together with a 50 ft. third-class coach seating 46 passengers. At the outward end of the latter the fittings of one compartment have been removed to make a driving compartment, and here also there is space for a small quantity of luggage. The 48 ft. coach weighs 25½ tons, and the 50 ft. vehicle 26½ tons, empty in each case.

With the exception of certain minor lines, all the other companies have found it advisable to construct special rolling stock for auto-working, generally speaking in view of the fact that the auto-trains call at intermediate "halts" which are not staffed, so that corridor coaches must be provided, and accompanied by a travelling conductor to issue and collect tickets *en route*. The Great Western Railway has built some particularly commodious vehicles of this character. The largest of these coaches measures no less than 75 ft. in length, and is carried on two four-wheeled bogies, weighing in all 29 tons. It has accommodation for 80 passengers, but no luggage compartment. A "unit" of two cars consists of a 73 ft. coach containing driving and luggage compartment and seating for 64 passengers, with a 70 ft. coach having accommodation for 80 passengers. A smaller vehicle for country branch lines is 59 ft. 6 in. long, with seating for 68 passengers and no luggage compartment. The Great Western auto-trains convey only third-class passengers, and are all of the open corridor type. The cars are arranged with transverse seats of the "walk-over" pattern in the centre, and longitudinal seats at each end; hand loops are provided from the roof for passengers' assistance. In most cases the cars are divided into smoking and non-smoking compartments. Entrance is obtained through side-doors at the driving end of the car, or from a vestibule at the opposite end, which may be employed for the storage of light luggage.

In addition to the compartment vehicles already described, the London and North Western Company has also a number of open corridor auto-coaches in service. The largest of these measure 57 ft. in length, and weigh 29 tons each. For third-class services a car, with luggage compartment, accommodating 62 passengers is employed, and for both classes one seating 16 first and 44 third-class passengers, with a luggage compartment in addition. For lighter branch services a 42 ft. coach, with luggage compartment, is used, seating 48 third-class passengers. The London and South Western company forms a "unit" of two open corridor 48 ft. coaches, weighing 21 tons each: these are placed adjacent to each other, being vestibuled together and marshalled on one side of the engine. They seat together 113 passengers, and have accommodation for luggage. The London, Brighton and South Coast Company has built several different types of vehicle, all uniformly 54 ft. long, and in most instances working in pairs. One such "unit" consists of two open corridor coaches weighing 21 tons each, one containing driving and luggage compartment and seating 16 first and 50 third-class passengers, and the other seating 50 third-class passengers. A second "unit" is composed of two side-corridor coaches, as used on the South London electric service, one with driving and luggage compartment seating 54 passengers, and the other having seating accommodation for 19 first and 46 third-class passengers. A third vehicle is of the ordinary compartment type, and was not specially built: it is also 54 ft. long, and weighs 25 tons. This coach contains driving compartment with accommodation for luggage, and three first and four third-class compartments, seating 24 and 40 passengers respectively.

The other companies mentioned as having adopted the auto-train principle have in most instances constructed special coaches for the purpose. The rolling stock described will be noticed to cover all possible classes of traffic, and is often supplemented, in cases of need, by the addition of trailer coaches of the ordinary pattern for heavily loaded single journeys.

(C) Composition of Trains and Driving Arrangements.

The composition of the auto-train is dependent on the volume of traffic which is conveyed on the particular service. For the conveyance of a limited number of passengers one coach is attached to the locomotive, which pulls the coach on the forward journey and pushes it on the return. For what might be called "normal" working, where two coaches are required, they are generally marshalled together on one side of the engine, and similarly pulled on the outward journey and pushed on the return. In the first of these cases there must be a driving

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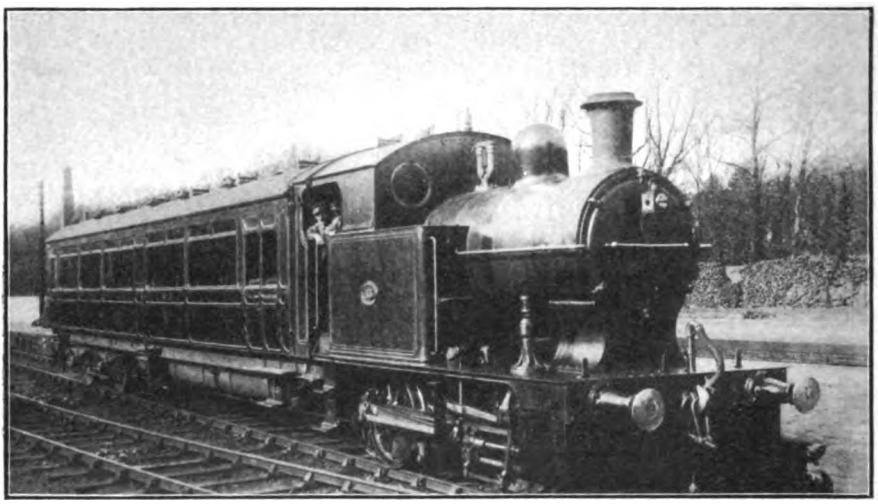
compartment at the outward end of the coach, and in the second at the corresponding end of the second coach. On the forward journey, therefore, the driver works the locomotive from the footplate, and on the return he drives from the driving compartment on the coach, leaving the fireman in charge on the footplate.

An alternative arrangement practised by the North Eastern and Midland Railways in the case of two-coach auto-trains, is to marshal one coach on either side of the engine. This plan, however, requires the provision of two special driving compartments, with all the necessary fittings and connections to the footplate, while the driver is at no time driving from the footplate. There is an additional disadvantage in that, if the auto-train is required to work a service on which tickets are taken and collected *en route*, two conductors will be required, as it is obviously impossible to vestibule the two coaches together when they are separated by the engine. It may be noted, however, that neither the Midland nor the North Eastern Companies operate any such services, all their coaches, as previously mentioned, being of the compartment type.

In the case of exceptionally heavy traffic the general practice is to attach two of the two-coach "units," one on either side of the engine. Further than this, certain of the London, Brighton and South Coast auto-trains have occasionally been worked with a unit of three vehicles marshalled on each side of the engine. In the case of such four and six-coach auto-trains, of course, two driving compartments are necessary at each outward end of the train, in one of which the driver is always located, the fireman remaining on the footplate. Where tickets are taken and issued *en route*, the provision of two conductors is unavoidable in this instance, but the larger number of passengers conveyed is sufficient to warrant this increase in the train staff. Trailer coaches may, of course, be added in all cases to meet exceptional requirements, up to the tractive capacity of the locomotive, but these must be detached at the end of the forward journey, as otherwise they would obstruct the look-out when returning, as well as causing an excess in the number of vehicles that it is allowable to push.



Photo] [*E. Mason.*

LANCASHIRE AND YORKSHIRE RAILWAY.
Rail Motor Car at Lytham.

From the point of view of driving the auto-train offers special advantages. Where the coach or coaches are marshalled on one side of the engine, the latter is always attached to them at the bunker end, with the chimney outwards. Consequently when the driver is on the footplate he enjoys the best look-out that it affords, whereas when driving from the coach, with the large front windows usually provided, his view of the track and signals is absolutely unobstructed. Where coaches are marshalled on both sides of the engine, the driver performs his work under the most ideal conditions possible, with a

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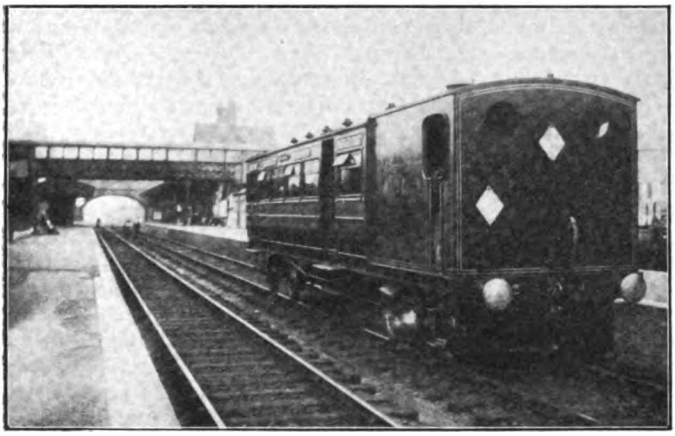

Photo] [*F. H. Stingemore.*

LONDON AND SOUTH WESTERN RAILWAY.
Rail Motor Car No. 1 leaving Hounslow and Whitton Station.

perfect look-out and with none of the distractions or discomfort of the footplate. Connections are always made from each driving compartment to the regulator handle, brake-valve, and whistle on the footplate, and occasionally to the reversing gear. If the latter connection is not made, there is usually communication arranged in the form of a speaking-tube, so that the driver may be able to instruct his fireman to reverse the engine when necessary. On the Great Eastern Railway this communication is in the form of an electric single-stroke bell, as used in signalling, whereby the driver is enabled to communicate with the fireman in accordance with a prearranged code. In the ordinary course, when the engine is reversed, the driver proceeds to the driving compartment at the opposite end of the train, but there may, of course, be occasions when the engine requires to be set back, as, for instance, if it comes to a stand on the dead centre. In fact, it is the rule rather than the exception for speaking communication to be provided, as it is frequently necessary for the driver to give the fireman instructions when absent from the footplate. The connections are made between locomotive and driving compartment either under the underframes of the intervening coaches, or, as in the case of the London and South Western Railway, along the roofs.

(D) Stopping Places and Ticket Arrangements.

The auto-train, just as the original rail-motor coach, lends itself admirably to the practice of erecting small and inexpensive stopping-places or "halts," as distinct from the ordinary stations. By thus installing miniature stations at any points where it seems likely that traffic may be gained, if only in small amounts, the facilities of road traction are as nearly as possible imitated, and the railway company is better equipped to meet the difficulties of road competition. This is particularly the case in the suburban districts of towns, where much traffic is lost to the railway in consequence of the road vehicles affording transit from door-to-door, whereas in the case of a railway a walk is probably involved to the nearest station, with an equally probable wait for the train on arrival. By the employment of auto-trains running at more frequent intervals than the ordinary trains, together with the provision of "halts" at intermediate points, these disadvantages are minimised, and the superior speed of the trains as compared with the road vehicles affords the railway a far more effective means of competition. Similarly in country districts the use of auto-trains, coupled with the erection of "halts" in the neighbourhood of the smaller villages unprovided with stations, have in not a few instances been successful in developing the traffic on branch lines to a remarkable degree.

The character of the "halts" is determined, generally speaking, by the type of rolling stock employed on the train, as, if the latter be not composed of corridor vehicles and accompanied by a conductor to issue tickets *en route*, provision must be made for doing so at the halt, and a man placed in charge. The erection of a booking office at the halt, even if small, practically converts it into a station, rendering it liable to be rated as such, and this practice is not frequently adopted. Generally speaking, the halt consists of a timber platform, sufficiently long to accommodate two or four coaches, according to the requirements of the particular service, and the locomotives. Lighting has to be provided, and corrugated iron shelters with seats are sometimes added also. The cost of equipment usually varies from a minimum of £50 for a single platform halt to

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a maximum of £200 for one on a double line with two platforms, which is obviously a very moderate outlay as compared with the cost of an ordinary station. The adjacent stations are then usually made responsible for the cleaning and lighting, sending a man along daily for this purpose.

Where corridor stock is employed, the general practice is for the guard or conductor who accompanies the train to issue tickets to passengers joining at the halts, and to collect them from those alighting, while tickets are issued to the halts, and those issued from the halts are collected at the stations in the ordinary way. Tickets to stations beyond those served by the auto-train are secured by re-booking at the terminal station. The conductor is usually supplied with tickets and a bell-punch of the tramcar pattern. The Great Western Railway has, in certain cases, installed automatic machines at the halts for the issue of tickets. Parcels require to be brought to the trains and handed to the conductors, the booking being performed at adjacent stations, although in certain cases agents adjacent to the halts have been appointed to receive and forward parcels. In practically every case where compartment, as distinct from corridor, coaches are employed for auto-train purposes, halts are not in use, so that tickets are issued and collected by the staff at the existing stations in the ordinary way.

(E) Some Notes on Auto-Train Working.

The general uses of auto-trains are perhaps best illustrated by the train services of the North Eastern Railway, on which they are extensively used. They make their appearance daily on 50 of the main and branch services of that company, working certain of them exclusively, and on others taking several of the lighter turns only. In this way they cover a total of 709 different miles of the North Eastern system each day. The total number of services worked exclusively by auto-trains is six, the most important of which is the ½-hourly service between Hartlepool and West Hartlepool, a 2½-mile distance for which a journey time of 6 min. is allowed.

Another service worked entirely by "auto-cars," as they are known in the North Eastern Railway, is that from Middlesbrough to Saltburn *viâ* Guisborough, and illustrates forcibly the peculiar advantages of this type of vehicle for certain kinds of journeys. Guisborough itself is on a short spur from the through line, so that each train must be reversed on starting from that station, and again on reaching the junction with the through line before proceeding. Again, the junction at Saltburn with the direct Middlesbrough-Saltburn line is trailing, as viewed from the station, instead of facing, so that a further reverse is needed here. Lastly, certain of these trains run into Brotton before reaching Saltburn by means of a triangular junction with the coast line to Whitby, necessitating a fourth reverse on the one journey in such cases. Prior to the adoption of auto-cars the locomotives thus had to run round their trains no less than three or four times per journey, resulting in a loss of time of anything from 3 to 4 min. at each reverse, whereas all the time now consumed is that which the driver takes to walk from one end of the train to the other. Two other North Eastern services, on which auto-cars provide the only through facilities, have similar reverses on the journey. They are those from Morpeth to Newbiggin, reversing at Bedlington, and Morpeth to Blyth, reversing at Newsham. On such services as these the auto-train proves itself

Photo] [*F. H. Stingemore.*

LONDON AND SOUTH WESTERN RAILWAY.

Inspection engine and saloon (No. 733) passing through Hounslow and Whitton Station.

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invaluable as an economiser of journey time.

The North Eastern Railway Company also makes a practice of stationing auto-cars at various centres of traffic, and using them for miscellaneous purposes. Some of these cars make non-stop runs exceeding 20 miles, at average speeds varying from 35 to 38 miles per hour, as, for instance, from Durham to Darlington, 22 miles, or from York to Harrogate, 20½ miles. Others, again, perform continuous journeys of considerable length. For example, the auto-car stationed at Berwick leaves daily in the summer at 10.53 a.m. for Alnwick *via* Alnmouth, a distance of 35¼ miles in all, with a reverse at the last-mentioned station. The journey occupies 1 hour 41 min., and, after a break of 36 min. the return journey, occupying 1 hour 20 min., is undertaken. In the latter case the time allowed for reversing at Alnmouth Junction is only 1 min., which would obviously be impossible had the engine to run round its train. Fifty-two min. elapse before a second similar return journey to Alnmouth is commenced, occupying a total of 2 hours 48 min., with but 15 min. allowed at Alnmouth Junction. In all, therefore, a total distance of 135 miles is covered. Similar instances might be cited elsewhere on the particular system named, where auto-cars undertake quite extensive tours from the centre at which they are stationed, the margins of time allowed for reversing at terminals and for locomotive requirements being, generally speaking, considerably less than are allowed in ordinary working.

As regards mileage, however, that just mentioned is quite small as compared with what is frequently done elsewhere. The Great Western Southall and Brentford auto-train for some years worked a daily mileage exceeding 300, until certain alterations were made in the train services. On Bank Holidays the Princes Risborough and Banbury auto-train of the same company works five trips each way between these two towns, totalling 327½ miles. A record was achieved during the last Coronation holidays when the last-mentioned auto-train worked seven return journeys between Princes Risborough and Banbury, totalling no less than 458½ miles.

Some of the most important auto-train services at present in operation are those between Euston and Watford, while before electrification they worked the whole of the Willesden-Earl's Court service, running at about ¼-hourly intervals. Usually there is a locomotive and two coaches marshalled on one side, or a locomotive and four coaches, two each arranged on either side, according to the density of the traffic. Another well-patronised auto-train service, on which the number of passengers conveyed, by a frequent service, averages 100 to 300 per trip, is that between Plymouth, Plympton and Saltash, Great Western Railway, serving an exceedingly populous district. A load of four open corridor coaches—one 70 ft. and one 73 ft. in pairs marshalled on either side of a 0–6–0 type tank locomotive—is also employed on some of the trips, together with even a fifth coach as a "trailer," attached at the busiest times.

From the foregoing notes it will, therefore, be apparent that the auto-train has now become a permanent feature of traffic operation in this country. As its advantages, which have been fully set forth in this article, become more widely recognised and appreciated, it is safe to predict for the new traffic "unit" a still more extended sphere of usefulness in the future.

In reference to remarks concerning the use of London and North Western 2–4–2 or 2–4–0 locomotives adapted for working "auto-trains," Mr. T. Geary writes from Cambridge pointing out that 0–6–2 passenger tank engine No. 2028 is fitted for such work, and was stationed for a time at Willesden, while No. 576, a mineral engine of similar type, was also fitted and was working at Abergavenny last summer. He understands that two other 0–6–2 engines are similarly adapted. As regards 2–4–0 engines on this line he mentions that engines of this type for ordinary use are stationed at Buxton, these having been employed there for some years and quite irrespective of any application for "auto-train" working.

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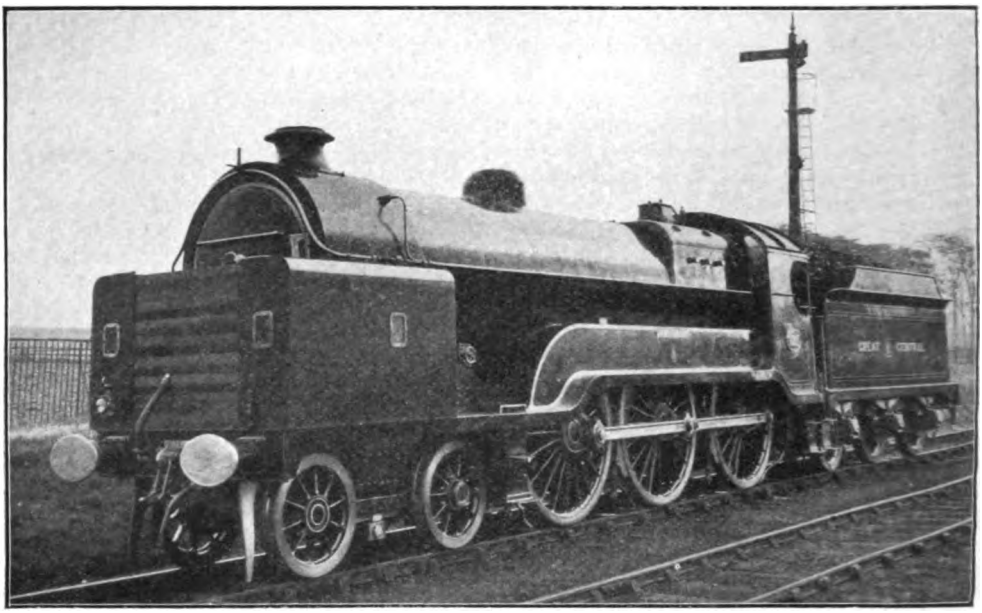

Photo] [*P. F. Cooke.*

GREAT CENTRAL RAILWAY.

Sir Sam Fay, No. 423, fitted with indicator shelters.

British Locomotive Practice and Performance.

By CECIL J. ALLEN.

IN the May issue I promised to prepare a tabular statement showing the vertical rise on all the chief main lines out of London, and this is reproduced herewith. A few remarks in explanation of its main features may now with advantage be made. In the first place, "vertical rise" obviously does *not* mean the difference in height above sea level between the start and finish of a journey. As mentioned last month, in the ascent of any gradient the engine has to "lift" the train against the pull of gravity in addition to overcoming the other resistances due to motion. The extent of vertical "lift" in negotiating any one grade is known as the "vertical rise," and if, therefore, the rises on every adverse grade during the journey be summed up, we get the total vertical rise between starting and finishing point. As the favourable grades are neglected, the total vertical rise on a down journey may differ considerably from that on the corresponding up journey, but the difference between these figures obviously represents the difference in actual level between the beginning and the end of the line in question.

The steeper the intermediate grades become, so much increased is the rise on the journey, and in this way the total vertical rise becomes a very useful guide to the cumulative effect of grading on any route. It is not an infallible guide—at any rate so far as locomotive performance is concerned—seeing that performance on hilly routes is influenced by various factors other than those of adverse gradients alone. Service slacks at the foot of uphill stretches of line (of which there are many instances, owing to the fact that the majority of our large towns and railway junctions are situated in valleys), winding descents, on which speed must be kept at a very moderate figure, water and other difficulties—all these hindrances complicate the problem of locomotive work on heavily-graded stretches of line.

I have calculated the heights given in the table from the published gradient profiles of

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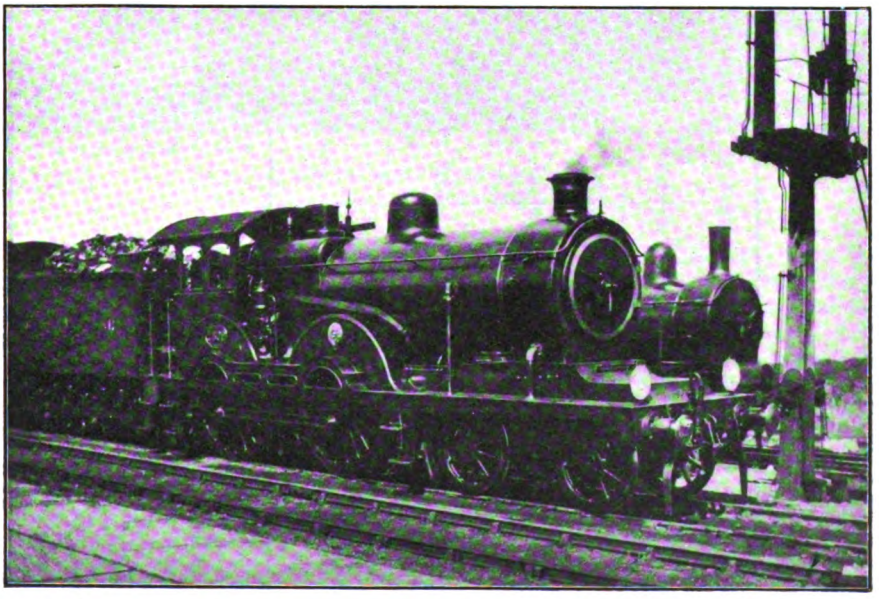
the various railways concerned. The absolute accuracy of these figures is not guaranteed, as in many cases the profiles were reproduced on a very small scale: if any reader, however, likes to commit himself to the self-denying effort of checking the calculations, I think he will find them fairly correct. As will be seen, the aggregate rise is given on each line at certain stated distances from London, the various "zones" being chosen in such a way as to cover as many as possible of the strategic points *en route*. Each zone is described as "about" so many miles, in order that fairly well-known intermediate points may be selected; the actual mileage of the latter from London will be familiar to most readers, or can easily be found by reference to "Bradshaw." A key to the stations is given below the table. In one or two cases, owing to a disparity in mileage, the names of towns are given instead of a zone of so many miles.

In the first column appears the old Great Western West of England main line *viâ* Bath, which has by far the most perfect grading of any in the country. As far as Taunton, indeed, the aggregate rise is less than that of any other main line out of London (the London and North Western Railway alone excepted) for barely one-third of the distance, the Great Central rise to Calvert *viâ* Aylesbury, for instance, being exactly *twice* that of the Great Western Railway to Taunton, with a distance of 48 miles against 163 miles! The Westbury route, although 20 miles shorter, adds 350 ft. to the aggregate rise, as the gradients are more severe, but as far as Taunton even this is the easiest, from the grading point of view, of all the main lines from London. Wellington bank is responsible for an increase of 320 ft. to Exeter, while the very heavy grades from Newton Abbot to Plymouth add no less than 760 ft. to the rise, giving a total of 1,880 ft. from London to Plymouth *viâ* Westbury.

The London and South Western Weymouth line is one of comparatively easy gradients; for the first hundred miles, indeed, it ties with the London and North Western figures, although there are some stiff gradients between Wareham and Weymouth. From Salisbury, onwards, however, the Plymouth line of the same company easily puts all competitors in the shade. Between Salisbury and Exeter, 88 miles, an increase of no less than 1,520 ft. of vertical rise is added, beating the figures of the Great Central Railway (the next heaviest graded from zone 80 to zone 160) by a modest 610 ft. Beyond Exeter, of course, the South Western has a perfectly mountainous line, the aggregate rise from London to Plymouth



Photo] [*R. H. Rose.*

GREAT EASTERN RAILWAY.

No. 1809 on 5.26 p.m. express *ex*-Cromer, ready to start.

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THE GRADING OF BRITISH MAIN LINES.

TOTAL VERTICAL RISE (IN FEET).

DISTANCES FROM LONDON.	G.W.R.		L. & S.W.R.		L.&N.W.R.	MIDLAND R.			G.C.R.		G.N.R.	G.E.R.
	Viâ Bristol.	*Viâ* Westbury	*Viâ* Winch'st'r	*Viâ* Salisbury	Main Line.	Main Line.	*Viâ* Nottingham	*Viâ* Sheffield	*Viâ* Aylesbury	*Viâ* Wycombe	Main Line	Main Line
About 50 miles ..	Did. 130	Nby. 200	W.J. 420	W.J. 420	Bly. 360	Bed. 570	Bed. 570	Bed. 570	Cal. 820	Cal. 580	S.N. 490	Col. 550
,, 80 ,, ..	Swn. 230	Pat. 460	Stn. 470	Sal. 620	Rug. 560	M.H. 1100	Wel. 1020	M.H. 1100	Rug. 1230	Rug. 990	Pet. 640	Sto. 830
,, 100 ,, ..	Box. 290	Fro. 570	Chr. 650	Sem. 930	Nun. 650	Lei. 1250	M.M. 1210	Lei. 1250	Lei. 1390	Lei. 1150	S.B. 970	Tiv. 1080
,, 120 ,, ..	Brl. 290	Som. 690	Whm. 810	Y.J. 1170	Rgy. 740	Trt. 1260	Not. 1310	Trt. 1260	Not. 1510	Not. 1270	Nwk. 990	[Yar. 1690]
,, 140 ,, ..	Ble. 350	Tau. 760	Wey. 1150	Axr. 1490	N.B. 860	D.H. 1580	D.H. 1700	D.H. 1580	Kir. 1890	Kir. 1650	Ret. 1120	Cro. 1700
,, 160 ,, ..	Tau. 410	—	—	S.J. 1990	Cre. 950	—	[Shd. 1930]	Shd. 1810	Shd. 2140	Shd. 1900	Don. 1200	—
Exeter	730	1080	—	2140	—	—	—	—	—	—	—	—
Manchester ..	—	—	—	—	[1080]	[2250]	—	—	2900	2660	—	—
About 190 miles ..	—	N.A. 1120	—	Oke. 2930	War. 1030	Lds. 1740	Lds. 1860	Lds. 2000	—	—	{Yrk. 1350 {[Lds. 1670]}	—
Plymouth ..	1530	1880	—	3510	—	—	—	—	—	—	—	—
About 265 miles ..	—	—	—	—	S.S. 2380	A.G. 2980	A.G. 3100	A.G. 3240	—	—	New. 1830	—
,, 300 ,, ..	—	—	—	—	Car. 2400	Car. 315	Car. 3270	Car. 3410	—	—	A.J. 2070	—
,, 350 ,, ..	—	—	—	—	B.S. 3540	[Haw. 4180]	[Haw. 4300]	[Haw. 4440]	—	—	G.H. 2650	—
Edinburgh ..	—	—	—	—	[3900]	5080]	5200]	5340]	—	—	2890	—
Glasgow	—	—	—	—	3760	4380	4500	4640	—	—	—	—

A.G.— Ais Gill.
A.J.— Alnmouth Jc.
Axr.— Axminster.
B.S.— Beattock Summit.
Bed.—Bedford.
Ble.— Bleadon.
Bly.— Bletchley.
Brl.— Bristol.
Cal.— Calvert.
Car.— Carlisle.
Chr.— Christchurch.
Col.— Colchester.
Cre.— Crewe.
Cro.— Cromer.
D.H.— Doe Hill.
Did.— Didcot.
Don.— Doncaster
Fro.— Frome.
G.H.— Grant's House.
Haw.—Hawick.
Kir.— Kirkby.
Lds.— Leeds.
Lei.— Leicester.
M.H.—Market Harboro'.
M.M.— Melton Mowbray.
N.A.— Newton Abbot.
N.B.— Norton Bridge.
Nby.—Newbury.
New.—Newcastle.
Not.— Nottingham.
Nun.— Nuneaton.
Nwk.—Newark.
Oke.— Okehampton.
Pat.— Patney.
Pet.— Peterborough.
Ret.— Retford.
Rgy.— Rugeley.
Rug.— Rugby.
S.B.— Stoke Box.
S.J.— Sidmouth Jc.
S.N.— St. Neots.
S.S.— Shap Summit.
Sal.— Salisbury.
Sem.—Semley.
Shd.—Sheffield.
Som.—Somerton.
Stn.— Southampton.
Sto.— Stowmarket.
Swn.—Swindon.
Tau.— Taunton.
Tiv.— Tivetshall.
Trt.— Trent.
W.J.— Worting Jc.
War.— Warrington.
Wel.— Weldon.
Wey.— Weymouth.
Whm.—Wareham.
Y.J.— Yeovil Jc.
Yar.— Yarmouth.
Yrk.— York.

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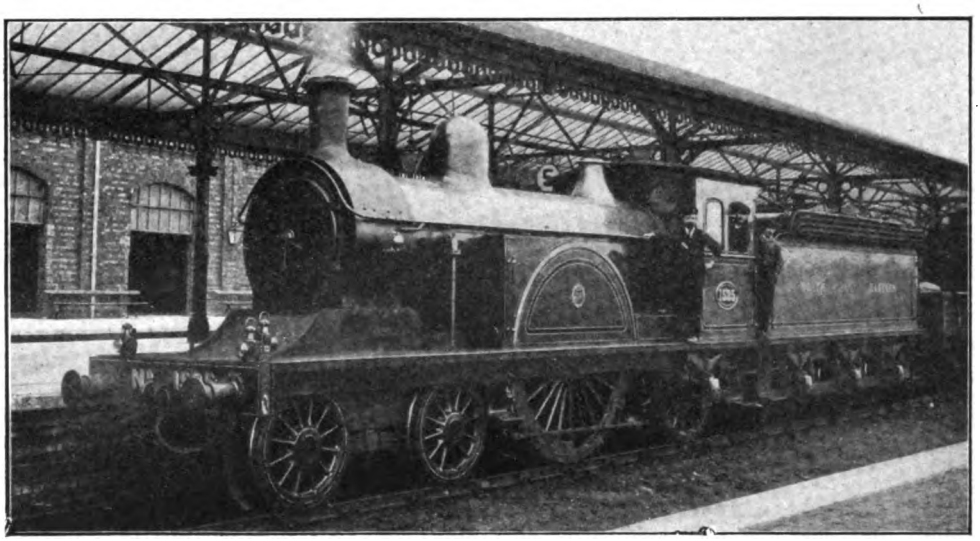
being within 250 ft. of the height of Snowdon! The London and South Western Railway rightly has a reputation for difficulty in the matter of express locomotive work.

As far as Warrington the London and North Western Railway boasts a main line of superb grading and alignment, equalled only by that of the Great Western, and this fact fully explains why these two companies are able consistently to tackle heavier loads on high-speed schedules than any of their competitors. The sharp grades between Wigan and Preston, however, with the tremendous pull up to Shap summit, suffice to double the rise in the next 85 miles, while the ensuing 50 miles to Beattock summit are responsible for a further addition of 1,140 ft. It is curious to notice that the rise on the second half of the West Coast journey from London to Glasgow is almost exactly double that of the first half; in this way so clearly defined a change in the grading can be, and is, met when necessary by the division of trains or the provision of pilot engines, at Crewe, Wigan or Preston, as the case may be.

The Midland Railway is a line of severe grading throughout, and this difficulty is increased when the alternative routes *viâ* Nottingham and Sheffield are followed, the former adding 120 ft., and the latter, on account of its stiff pull up to Bradway tunnel, as much as 260 ft. to the total rise. From Leeds to Ais Gill summit there is a practically continuous rise, this comparatively short ascent accounting for 1,240 ft., but even this is nothing to the grades beyond Carlisle on the "Waverley" route of the North British Railway. The latter, with its long continuous stretches at 1 in 80 and 1 in 90 inclination is probably the most difficult stretch of main line in the country, as, although the distance between Carlisle and Edinburgh is only 98¼ miles, the aggregate vertical rise is no less than 1,930 ft. Consequently the aggregate rise from London to Edinburgh by the Midland route, even avoiding Nottingham and Sheffield, is 5,080 ft.—675 ft. higher than Ben Nevis, the highest point in the British Isles! Between Carlisle and Glasgow, also, the Glasgow and South Western Railway has by no means an easy route, the rise being only 130 ft. less than that of the Caledonian Railway between these points. Another mountainous section of the Midland Railway is that from Derby to Manchester, and, as will be seen, the vertical rise from London to Manchester by Midland route is more than double that of the competing London and North Western line.

But, of the Northern main lines, it is the Great Central that has by far the worst road to traverse. If the Aylesbury route is followed, the Great Central Railway leads all competitors by a substantial margin (with one trifling exception) in every "zone" from London to Manchester, where



Photo] [*P. F. Cooke.*

NORTH EASTERN RAILWAY.

4-2-2 locomotive No. 1525 at Bridlington.

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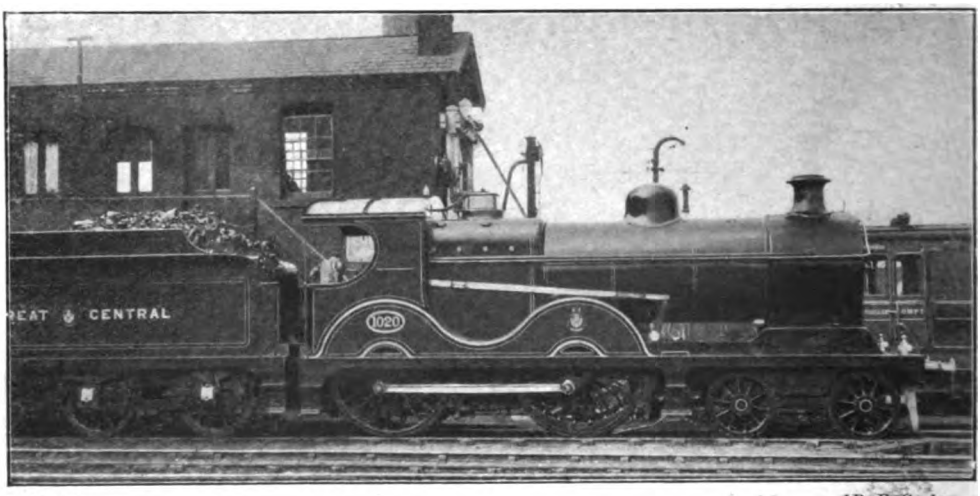
even the Midland, inclusive of Peak Forest summit, is beaten by a handsome 650 ft. It is very instructive to notice how the successive main routes to the north, in chronological order of construction, compare in the matter of grading, and this comparison is afforded by the table, the London and North Western Railway leading, followed by the Great Northern and then the Midland, with the Great Central, whose main line to London was not opened till 1899, by far the most severely handicapped in the matter of grades. The construction of the Great Western and Great Central Joint Line, *viâ* High Wycombe, has given the Great Central Railway relief to the extent of 240 ft. in the matter of vertical rise, and is thus very useful for heavy mineral traffic and the Leeds the severe intervening grades, especially beyond Wakefield, leave the Great Northern Railway an advantage of only 70 ft. over their Midland competitor to Leeds. The Great Eastern Railway, as is well known, is much handicapped in the matter of grading and of inconvenient service slacks as well. Such a vertical rise as 1,690 ft. from London to Yarmouth, indeed, is astonishing, in view of the nominal flatness of the Eastern counties, and far exceeds any other height in the 120-mile "zone." The figure of 1,700 ft. in the case of Cromer, too, is no less surprising, and invests with no little merit the performance of such a train as the summer "Norfolk Coast Express," with its vast holiday loads. Many further points in connection with the table



Photo] [*P. F. Cooke.*

GREAT CENTRAL RAILWAY.

4-4-0 locomotive No. 1020, as rebuilt with "Robinson" superheater and larger boiler.

heavier express trains, but the "crack" expresses continue to follow the Aylesbury route, with its 4¼ miles' curtailment of the journey.

It is not possible to describe the Great Northern Railway as having a route of exceptional difficulty, but there are some long and steep "pulls" to be faced, which tell severely on the engines with such heavy loads as those of the Anglo-Scottish trains. Moreover, with but few intervening stretches of level road, this description fits the East Coast Route almost throughout, but the easier character of its northern section, as compared with the West Coast, gives a lower aggregate rise of 1,010 ft. between London and Edinburgh. Between Doncaster and

might be quoted, but I must now leave it to the individual study of readers, in the hope that it may prove of interest and utility to them.

My first task in the matter of performance is to illustrate the remarks made in the last article as to improved hill-climbing giving the driver a margin which consists in "the possibility of high downhill speeds when necessary, rather than the practice of very fast running on all occasions." I have been most fortunate in obtaining two logs on the Midland Railway of the work of the same driver—one timed by myself and the other recorded by a friend and sent me quite unexpectedly a couple of days later—which could not more aptly than they do give

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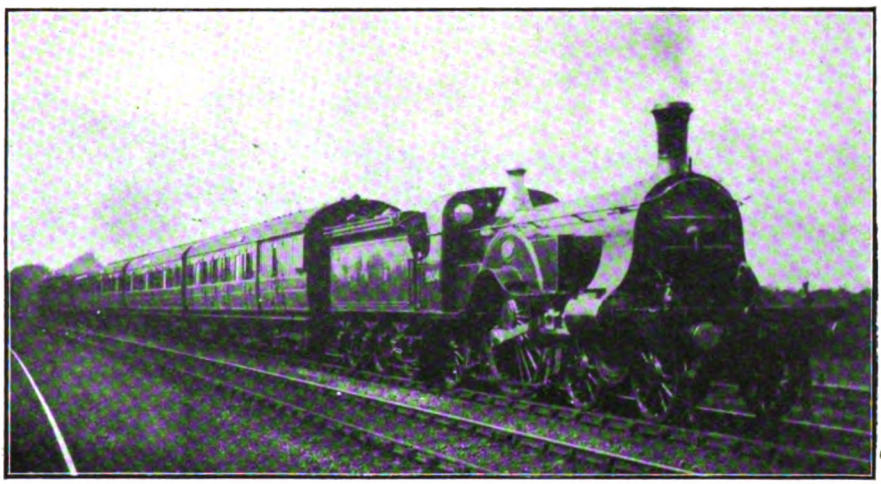
point to the argument just quoted. The driver in question was G. Leigh, of Trafford Park, and on my run his engine was the 4-4-0 compound No. 1018; he was in charge of the 3.3 p.m. (3.4 p.m. working time) express from Nottingham to St. Pancras, the load being eight corridor 8-wheelers, including dining cars—214 tons empty, and 225 tons with passengers and luggage. We were on time from Nottingham. The start was excellent, speed rising to a sustained 48·5 miles per hour on the long 7 miles' ascent at 1 in 200 to Widmerpool, which station, 8¼ miles from Nottingham, was passed in 12 min. 25 sec. Only 6 min. 40 sec. were taken for the easier graded, but still ascending 6 miles to Grimston, and we then ran rapidly down to Melton, slacking carefully at Melton Junction, and completing the 18¼ miles from Nottingham, start-to-stop, in 23½ min.

After a brief stop of 30 sec. we started again exactly on time, 24 min. after leaving Nottingham. Once again the initial grades are all rising, with the briefest intervals, at from 1 in 274 to 299, as far as Ashwell, 8¼ miles, but we covered this distance very smartly in 11 min. 40 sec., and passed Oakham, 11¼ miles, in 14 min. 55 sec. On the 1 in 143 descent to Manton we touched 72·5 miles per hour, but Leigh slackened very carefully for Manton points, after which we again went ahead on the 1 in 167 descent to Harringworth viaduct, and reached 71·4 miles per hour. Manton, 15 miles, was passed in 18 min., and Harringworth, 20¼ miles, in 22 min. 50 sec. Both these inclines were run over at a speed well below the "possible," of course, but another magnificent hill-climbing effort followed, the 5½ miles' ascent from Harringworth to Weldon being "rushed" with a minimum of exactly 50 miles per hour. So Weldon, 25¾ miles, was passed in 28¾ min., and with a most easy finish, we arrived at Kettering 37 min. 5 sec. after leaving Melton, a minute inside the schedule time for this 33¼ miles.

A punctual start was made from Kettering, and a very careful slack to cross over from the slow to the fast roads followed at Kettering South Junction, so that we took 9¾ min. to pass Wellingborough, 7 miles. The speed was by this time exactly 60 miles per hour, and we then went up Irchester bank—4 miles long, with the last 2 at 1 in 120—without the rate falling below 44 miles per hour. Sharnbrook summit, 12¼ miles, was passed in 15¾ min. from Kettering. A maximum of 72·5 miles per hour was attained on Sharnbrook bank, after which steam was shut off for the remainder of the descent. In this way it took us 25 min. 20 sec. to pass Bedford, instead of the 23 min. booked, although it must be confessed that the latter is indeed a "counsel of perfection" for this 22¼ miles' stretch.

But the climbing from Bedford to Toddington was really magnificent. After a continuous ascent of 8 miles to Ampthill, including 1 at 1 in 184 and nearly 4 at 1 in



Photo] [*R. Hall.*

GREAT NORTHERN RAILWAY.

Up Cambridge express, drawn by 8 ft. single engine No. 1004.

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200, our lowest speed was 51·1 miles per hour, while the unbroken 6¼ miles at 1 in 202 from Flitwick to Toddington only brought us down to 51·7 miles per hour. Thus our time for the 8 miles from Bedford to Ampthill was 8 min. 10 sec., and for the 9 miles from Ampthill to Leagrave 9 min. 40 sec.; from Bedford to Luton we had taken 20 min. 10 sec. for the 19½ miles, against the sharp booking of 21 min. Luton was passed at 69·2 miles per hour, and we then ran smartly on to St. Albans, this 10¼ miles consuming 9¼ min. Once again, after attaining a rate of 70 miles an hour on the descent to Radlett, Leigh shut off steam, as we were practically on time, and we came quite gently into St. Pancras, the 13¼ miles from St. Albans to Hendon taking 12 min., and the final 7 miles into the terminus 8 min. 55 sec. We were half-a-minute early on arrival, having adhered closely to schedule throughout, although the downhill speeds were most moderate.

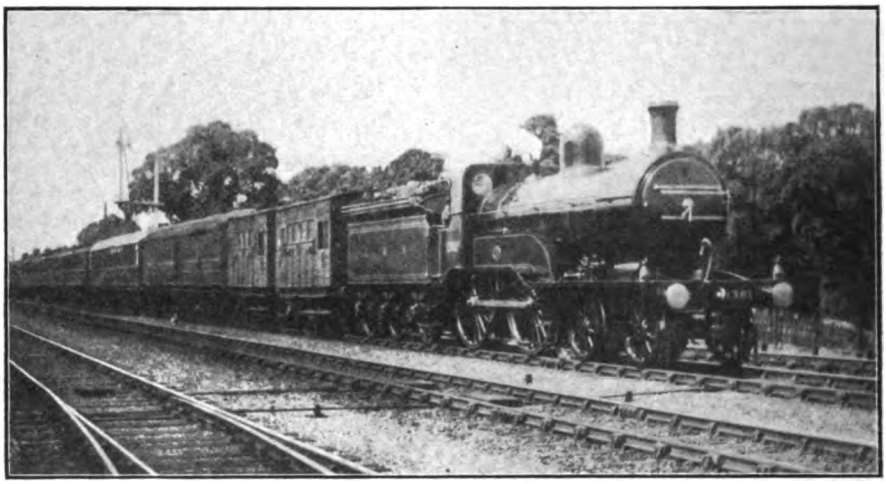

Photo [*R. Hall.*

GREAT NORTHERN RAILWAY.

Up Harrogate express, drawn by 4–4–0 engine No. 1381, rebuilt and fitted with superheater.

On the occasion of my correspondent's run, however, which was made on the 11.38 a.m. non-stop express from Derby to St. Pancras, the start was 4 min. late, and driver Leigh was in charge of compound No. 1014, with a total load behind the tender of 210 tons. This was a trifle less than the load on my journey, but the engine had to contend with a very strong south-west wind and driving showers. On the slightly falling grades to Trent a maximum speed of 70 miles an hour was reached, and Sawley Junction, 8¼ miles, was passed in 10 min. 2 sec. A slight check was made here, but excellent work followed on the gradually rising stretch to Leicester (mostly averaging 1 in 500), on which the speed was sustained at over the mile-a-minute rate. Loughborough, 17 miles, was passed in 19 min. 34 sec., and Leicester, 29½ miles—at the usual much reduced speed—in 32 min. 29 sec. The practically unbroken ascent from Leicester to Kibworth was taken in splendid style, speed rising to 57 miles per hour on the easier portion, and only falling to 54 on the final 1½ miles at 1 in 158; the subsequent descent to East Langton produced a maximum rate of 71 miles per hour. A slight slack was made through Market Harborough, which was passed in 17 min. 49 sec. from Leicester (16 miles), and the long 4 miles' ascent at 1 in 132 to Desborough did not bring the speed below 44 miles per hour. On the descent to Kettering a maximum rate of 77 miles an hour was touched, the 11 miles from Harborough having taken only 11 min. 21 sec. It is but rarely that the exceedingly difficult booking of 29 min. from Leicester to Kettering is observed within 10 sec., as was the case on this run.

From Kettering to London the comparison with my own run is instructive. The 7 miles from Kettering to Wellingborough occupied 5 min. 56 sec., after which a bad permanent way check ensued on Irchester bank. Nevertheless the speed recovered from 15 to 34 miles an hour on the 1 in 120. Now,

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as the train was behind time, Leigh went down Sharnbrook bank at a maximum of 80·3 miles per hour, although he slacked over Oakley troughs; further time was then lost by a signal check outside Bedford. With these delays the 15¼ miles from Wellingborough to Bedford had taken 16 min. 25 sec. On the rise to Ampthill the speed did not fall below 52 miles per hour, but a second slight signal check spoiled the further ascent to Toddington, although the speed on the 1 in 200 actually rose to 50 miles per hour before the summit was breasted. In this way the time from Bedford to Luton was 22½ min., nearly 3 min. having been lost on schedule between Wellingborough and Luton

But now there remained the "possibility of high downhill speeds when necessary," of which driver Leigh took full advantage. The time for the 10¼ miles from Luton to St. Albans was 9½ min., and then the maximum both at Radlett and through Hendon was 77 miles per hour, even the 3 miles ascent at 1 in 200 to Elstree tunnel not bringing the rate below 64 miles per hour. From St. Albans to Cricklewood, 14¾ miles, only 12 min. 21 sec. were taken, the last 5¼ miles into the terminus occupying 6 min. 9 sec. The time for the 20 miles from St. Albans into St. Pancras was thus 18½ min.—against my 20 min. 55 sec.—and the arrival was actually ½ min. early, Leigh having achieved the fine feat of running from Derby to London, inclusive of all delays, in 134½ min. A conservative allowance for the latter leaves the net time at 130¾ min., or 7¼ min. under the working time, giving an end-to-end average, for this 129½ miles' journey, of 59 miles per hour. Such performance as is exhibited on these two runs is surely of an ideal character, with its consistently fine uphill work and high downhill speeds only when necessary to regain time.

I enjoyed a companion run to the above on the Great Western Railway recently. The train in question was the 4 p.m. express from Paddington to Birmingham, hauled by the 4-cylinder 4–6–0 engine 4007, *Rising Star*, of which driver Parry was in charge. Our load was one of seven 8-wheelers, totalling 215 tons behind the tender at the start, but reduced by "slips" to 190 tons from Bicester, 160 tons from Leamington, and 130 tons from Lapworth. The start was inclined to be leisurely, as we took 11 min. 35 sec. for the first 7¾ miles to Greenford (including the usual slack at Old Oak Junction), but then we went ahead magnificently, attaining a rate of 64·3 miles per hour at Denham, and then breasting the long ascent at 1 in 175, 264 and 254 to near Beaconsfield without the speed falling below 57 miles per hour. In fact, on the final 1 in 254 it accelerated to 58·4 miles per hour, while a maximum of 75 was touched on the descent to High Wycombe. So the 7 miles from Greenford to Denham took 6 min. 35 sec.; the 6⅞ miles from Denham up to Beaconsfield 6 min. 50 sec.; and the 4⅞ miles from Beaconsfield to Wycombe 4¼ min. Wycombe, 26½ miles, was passed in 29¼ min. from Paddington at the usual reduced speed. Up Saunderton bank—4½ adverse miles, mainly at 1 in 164—we accelerated to 49 miles per hour, the 5 miles from Wycombe to Saunderton taking 6½ min., and the 3¼ miles on to Princes Risborough 3 min. 20 sec.

We were now treated to a tremendous burst of speed, the favourable stretch beyond Risborough tempting our driver to a maximum of 86·5 miles per hour, while the rate had not fallen below 81·8 when we slackened for Ashendon Junction. Consequently our time for the 9⅜ miles from Risborough to Ashendon was the record one of 7 min.—an average of exactly 80 miles per hour for this distance. Ashendon, 44⅛ miles from Paddington, was passed in 46 min. 5 sec. from the start. But now delays supervened. We were badly checked by signal at Brill and brought down to a walking pace at Blackthorn, taking thus 12¼ min. for the 9⅜ miles from Ashendon to Bicester, and 4 min. 25 sec. for the 3¾ miles from Bicester up to Ardley, but we covered the 6¾ miles from Ardley to King's Sutton, inclusive of a careful slack past Aynho Junction, in exactly "even time." Our troubles were not yet over, however, as we were brought to a dead stand for 55 sec. between King's Sutton and Banbury, and further badly slowed right through Banbury station, on account of a Great Central empty stock train ahead. In this way we took 7 min. 35 sec. for the 3½ miles from King's Sutton to Banbury, and 9 min. 25 sec. for the 8½ uphill miles from Banbury to Fenny Compton. As the 26⅞ miles from Ashendon Junction to Cropredy had occupied no less than 36 min. 35 sec., it is evident from comparison with contemporary runs that this string of delays had cost us more than 9 min.

Once again we were now treated to some "high downhill speeds when necessary." On the 1 in 240 descent from Fenny Compton

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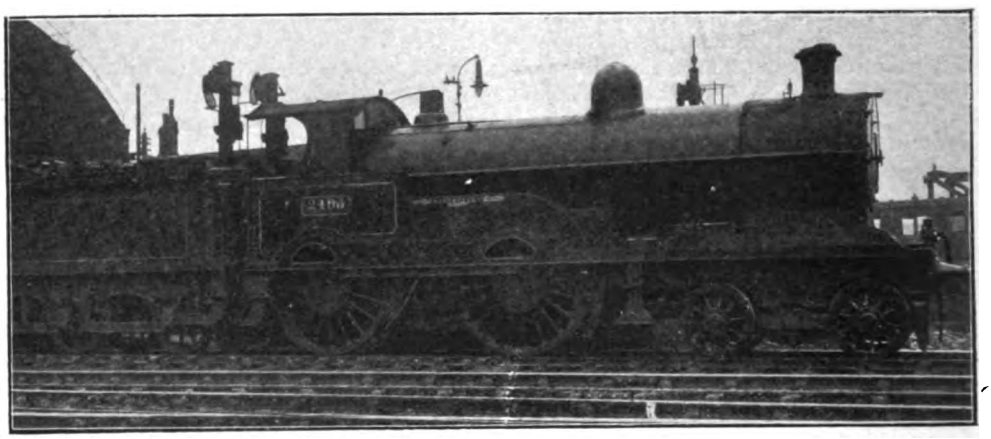
to Southam Road our sustained speed was 77·5 miles per hour, and on the succeeding 1 in 187 to Leamington, 81·8 miles per hour, maintained for some distance. Indeed, despite the usual prolonged check through Leamington, the 11¼ miles from Fenny Compton to the centre of the former station were reeled of in 9 min. 20 sec. Warwick, 2 miles further on, was passed in another 2 min. 40 sec., and the work with 160 tons up Hatton bank was magnificent, 3 adverse miles at 1 in 103–105 only reducing the speed from 57 to 53·6 miles per hour. The subsequent one-mile descent at 1 in 169 raised the speed to 69·2 miles per hour, after which *Rising Star* went right up 4 miles of adverse grades (1 in 183–273) without the speed once falling below 63·8 miles per hour. Consequently our time from Warwick to Hatton, 4 miles, was 4 min. 35 sec., and from Hatton to Knowle, 6¾ miles, only 6 min. 10 sec. After this superb running followed on the undulating but generally level stretch on to Birmingham, over which our sustained speed was 75 miles per hour, the 7¼ miles from Knowle to Tyseley taking exactly 6 min., and at Tyseley we had ample time to make a punctual arrival, had it not been for the very severe caution in force past the Bordesley widening works. This caused the final 3¼ miles to take 5 min. 50 sec., and made our actual arrival time 1 min. 5 sec. late, the whole journey of 110½ miles, delays included, having occupied 121 min. 5 sec. But with one dead stand for signals, three other very severe signal checks, and a long and bad permanent way caution, these delays could not have cost less than 11 min., leaving a net time of 110 min. for the 110½ miles from London. A time of 28¾ min. for the 31¼ miles from Fenny Compton to Tyseley (including, as it did, the long Leamington slack, made no whit less vigorously than usual) was one of which driver Parry, under these circumstances of delay, might well feel proud. Indeed, the whole run was another splendid example of painstaking and persistent effort to regain arrears of time.

The locomotive work of the Great Central Railway comes into prominence in the consideration of "vertical rise," with which this article opened, and was dealt with fully in the last issue as regards the up journey, but I wish to supplement these notes with some in the opposite direction of running, on the famous "Sheffield Special." As most readers will know, this train is now booked to call at Leicester and Nottingham daily, on account of the cancellation of the through Bournemouth-York express, which immediately precedes the "special" from Woodford to Sheffield. Our old friend "Bradshaw" would have us believe that the arrival time in Sheffield is still 6.12 p.m., and that the intermediate bookings are—Marylebone to Leicester, 103 miles in 105 min.; Leicester to Nottingham, 23½ miles in 21 min. (*sic*); and Nottingham to Sheffield, 38¼ miles in 43 min.! But the amended working times are not quite so



Photo] [*P. F. Cooke.*

LONDON AND NORTH WESTERN RAILWAY.

No. 2495, *Bassethound*, arranged for superheater dampers to be controlled directly from regulator and with connection to valve passing through side of steam dome.

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startling as this. From London to Leicester the time is exactly the same as the old "slip" time, the arrival being 5.4 p.m.; from Leicester, which is left at 5.6 p.m., the 23½ miles to Nottingham are allowed 24 min., as in the case of the Barry-Newcastle through express; after 2 min. at Nottingham, the remaining distance to Sheffield is covered in 47 min. The arrival time at Sheffield is thus 6.19 p.m.—7 min. later than previously—but, if anything, the locomotive work required is harder than before, the Nottingham-Sheffield time in particular being very tight, and 2 min. faster than any booking previously in force. From Sheffield on to Manchester, as the load is now reduced by the loss of the two Bournemouth vehicles, the train is expedited, Manchester being reached at 7.29 p.m.—only 4 min. later than before, and just in time to catch the connecting 7.30 p.m. Cheshire Lines express to Warrington and Liverpool.

Before giving a run on the new schedule, I will describe my last trip on the non-stop booking to Sheffield, which was made in the final week of its existence. The load was the usual one of 180 tons to Leicester and 145 tons beyond, the engine being an "Atlantic"—No. 260—driven by Shann, of Gorton shed. Smart work was performed from the start, Harrow, 9¼ miles, being passed in 13 min. 10 sec., and Rickmansworth, 17¼ miles, in 21 min. 35 sec. Here speed was reduced to a much lower figure than usual, owing to permanent way operations in force, and our ascent of Chorley Wood bank was correspondingly hampered. But the speed rose on the continuous 1 in 105 ascent to a sustained 39·1 miles per hour, and Amersham, 23½ miles, was passed in 32 min. 10 sec. from the start. There now followed some very fast running, speed rising to 71·4 miles per hour before Great Missenden, and to a sustained 77·5 on the 1 in 117 of Wendover bank, so that the 14½ miles from Amersham to Aylesbury, where a decided check was made, took only 13 min. 5 sec. From there the 6¼ miles on to Quainton Road Junction, where speed was reduced to 50 miles per hour, took 6 min. 35 sec. We had thus covered the initial 44¼ miles in 51 min. 50 sec., despite the Rickmansworth check, and were now well "inside" booked time.

A further perceptible check was made at Grendon Underwood Junction, the 2½ miles between the two junctions taking 2¾ min. Some first-class hill-climbing followed. On the 2½ miles of Calvert bank (including 1¾ at 1 in 176), the lowest speed was 55·6 miles per hour; on the 5 miles of Finmere bank (3 at 1 in 176) it was 52·9; and on Brackley bank, 4½ miles long (3¾ at 1 in 176) we did not fall below 55·6 miles per hour. The short intervening descents beyond Calvert and Finmere produced maxima of 63·8 and 69·2 miles per hour respectively. Thus the 12½ miles from Grendon Junction to Brackley, almost entirely adverse, were covered in the splendid time of 12 min. 35 sec., while the 9¾ miles from Brackley on to Woodford took 9 min. 10 sec., including a maximum of 73·8 miles per hour at Culworth Junction. The time of 24½ min. for the 24¾ miles from Quainton Road to Woodford was exceptionally fine, as the booking of 24 min. between these points is but rarely observed or attempted. From Woodford to Charwelton the 2½ miles took 2¼ min., and now a speed exhibition was given, a maximum rate of 81·8 miles per hour being maintained for some distance down Catesby bank. In this way the 11¾ miles from Charwelton to Rugby only occupied 9 min. 50 sec. Our inclusive time of 88 min. 25 sec. from Marylebone to Rugby was one of the fastest I have ever had on this train, while the net time was little more than 87½ min. It is interesting at this point to note that 87 min. is the schedule time of the crack London and North Western down expresses to passing Rugby, with ½ mile less in point of distance to cover, and a vertical rise of only 560 ft. against the Great Central 1,230 ft.!

As we were now ahead of time, there was a very decided slackening of effort. In fact, the speed fell to under 45 miles per hour on Lutterworth bank, and we did not exceed 77·5 on the descent to Leicester, much of which was taken without steam. Thus the 19¾ miles from Rugby to Leicester took 19 min. 40 sec., our gross time from London being 5 sec. over 108 min., although even this was a minute under schedule. The usual slack was made through Leicester. Loughborough, 10 miles further, was passed in another 10 min. 20 sec., at 78·9 miles per hour, and the subsequent 2½ miles up at 1 in 176 were taken "flying," with no lower speed than 60. A speed of 78·9 miles per hour was also touched on the descent to Ruddington, the 4½ miles from Loughborough to East Leake taking 4 min. and the 8¼ miles thence to Arkwright Street 6¾ min. Nottingham (Victoria) was passed in 130 min. 40 sec. from London, the train being still just ahead of time. Once again the hill-climbing was

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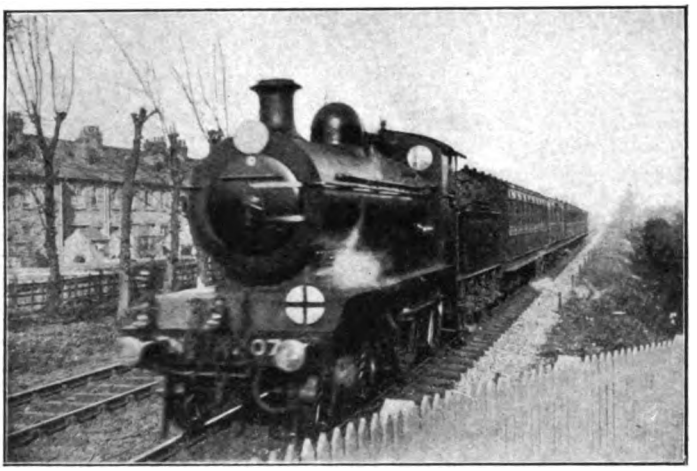

Photo] [*T. B. Welch.*

LONDON, BRIGHTON AND SOUTH COAST RAILWAY.

3.55 p.m. Brighton-Portsmouth train between Worthing and West Worthing. Rebuilt 4-4-0 locomotive No. 207.

very fine, the pace up the continuous 1 in 130 from Hucknall to Kirkby averaging all but 51 miles per hour; so the 11¾ miles from Nottingham (passed very slowly) to Kirkby, including nearly 9 at from 1 in 130–132, only consumed 15¼ min. After this the running was very moderate, the 8½ miles from Kirkby to Heath taking 8 min. 55 sec., inclusive of a severe permanent way check near the latter station; the 13 miles from Heath down to Woodhouse occupied 13 min. 50 sec.; and the last 5 miles into Sheffield, with a very slow stop, 7 min. 10 sec. Our total time from London was 175 min. 50 sec., or about 173½ min., allowing for the two checks *en route*, against the booking of 177 min., but with faster running from Rugby to Leicester and Heath to Sheffield it would have been easy to cut this time to 170 min. or less, so excellent was the uphill work throughout the journey.

For details of a run made since the inauguration of the altered times, I am indebted to the kindness of a correspondent. The most interesting feature of his log consists in the fact that the engine was the pioneer of the large 4–6–0 superheater class—No. 423, *Sir Sam Fay*—of whose work on an important express I have not yet seen any details in print. There was no Leicester slip-coach, of course, but an extra 60 ft. corridor eight-wheeler was added to the main train, making the total load throughout 185 tons behind the tender. A comparatively leisurely start was made, the time taken to Harrow being 13 min. 35 sec., and Rickmansworth 22 min. 25 sec. (50 sec. more than on my run), while for so powerful a locomotive the hill-climbing to Amersham was poor, the speed on Chorley Wood bank only averaging 39–40 miles per hour. But this is a curious example of hill-climbing "tradition," as from experience I find that the times observed by the "Atlantics" and "Directors" alike up this particular bank are almost always equally moderate. The speed on this occasion, it will be noted, was exactly the same as on my own run. So Amersham was passed in 32½ min., and a brisk descent past Wendover took the train through Aylesbury in 45 min. 50 sec., and Quainton Road Junction in 51 min. 50 sec. A slack to 45 miles per hour was made here.

Very good uphill work followed, as the minimum speed up Finmere bank was 56·3 miles per hour, and up Brackley bank exactly 60, the time from Quainton Road to Brackley being 15 min. 22 sec., and from there to Woodford, 9 min. 28 sec. On Catesby bank a maximum of 78·9 miles per hour was touched, Rugby being passed in 12 min. 53 sec. from Woodford, and 89 min. 33 sec. from Marylebone. A smart ascent to Lutterworth, with a minimum of 56·3 miles per hour, and a very easy descent to Leicester concluded the first stage of the run, the start-to-stop time from London to Leicester being 108 min. 25 sec., or comfortably within schedule. From Leicester the grades to Belgrave are almost entirely adverse, including 1¼ at 1 in 176, but the start was phenomenally fast, Rothley, 5 miles out, being reached in 6 min. 33 sec.; Loughborough, 10 miles, was passed in 10 min. 33 sec.; East Leake, 14½ miles, in 14 min. 48 sec.; and Arkwright Street, 22½ miles, in 22 min. 5 sec. The maximum speeds at Loughborough and Ruddington were 76·3 and 75 miles per hour respectively, and the minimum on the intervening rise 58·4. Nottingham was reached in 23 min. 43 sec. from Leicester—again just inside schedule. An exceedingly smart start was made also from Nottingham, the 5¾ miles out to Hucknall Town (including 2 up at

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1 in 130) taking only 8 min. 17 sec. But the remaining ascent to Kirkby was not so fast as on my run, the Hucknall-Kirkby stretch consuming 7½ min., with a minimum of 44 miles per hour, and the succeeding length from Kirkby to Heath 9 min. 35 sec. An easy descent followed from Heath to Sheffield, this distance occupying 20 min. 53 sec. with a signal check at Woodhouse. The total time from Nottingham to Sheffield was, therefore, 46¼ min., the net time of 45½ min. showing a further gain of 1½ min. on schedule. It is evident from these details that, as my correspondent remarks, the big engine observed the amended booking of the train with "the utmost of ease."

But in my opinion the work on both these runs, fine though it was, is completely eclipsed by the performance of a superheater "Atlantic" that I was fortunate enough to record on the same train a few days ago between Sheffield and Manchester. Considering the character of the road, the accelerated timing of this train between Sheffield and Guide Bridge makes this probably the hardest part of the journey for the driver, who always, by the way, works right through from London to Manchester, the engine hailing respectively from Neasden and Gorton sheds on alternate days. Our load on this occasion was four corridor eight-wheelers, with a slip coach for Penistone, and as the main train is now equipped with Mr. Robinson's weighty appliances for preventing the vehicles from telescoping if in collision, the total weight of the corridor portion, with passengers and luggage, was not less than 155 tons, and 180 tons as far as Penistone. The engine was No. 1086, 4–4–2, fitted with the Robinson superheater.

From Sheffield there is a level start for ¾-mile, followed by 4 miles up at 1 in 132 to Oughty Bridge. On this stretch we accelerated to 40·9 miles per hour, covering the first 4¾ miles in 8½ min. Then follows a continuous length of exactly 5 miles up at 1 in 120; 4 miles of this distance, to Wortley, were covered in 5 min. 40 sec., the speed at Wortley station having risen to 43·7 miles per hour. From Wortley to Penistone we have the remaining mile at 1 in 120, succeeded by 1¾ miles at 1 in 131, a mile at 1 in 160, and a mile at 1 in 100, on which stands Penistone station; this 4¼-miles' length occupied 5 min. 25 sec., and we passed Penistone at the somewhat unique speed, for this direction of running, of 47·4 miles per hour! The remainder of the climb consists of 1½ miles at 1 in 130, 1¾ at 1 in 124, and 2½ at 1 in 135 to the mouth of Woodhead Tunnel. On this section our speed actually rose to within a fraction of 50 miles per hour—49·5, to be exact—so that the 6 miles from Penistone to Dunford Bridge only took 7 min. 35 sec.! Thus, with the by no means inconsiderable load of 180 tons, we had covered the 13 miles from Sheffield to Penistone in 19 min. 35 sec., and with 155 tons beyond, the 19 miles from Sheffield to Dunford Bridge in 27 min. 10 sec., despite the fact that practically the whole distance is adversely inclined at an average grade of 1 in 120 to 1 in 135. This was, as our Yankee friends would say, "some" hill-climbing!

The rest of the journey was tame by comparison, no advantage whatever being taken of the falling grades on to Manchester. From Dunford Bridge to Woodhead the 3 miles took 3 min. 40 sec.; the 7¼ miles thence to Dinting occupied 7¼ min.; the 3¾ miles on to Godley Junction, 4½ min.; and the final 3¼ miles to the stop at Guide Bridge 4 min. 10 sec., these times including the usual slacks at Dinting and Godley, as well as a severe permanent way check beyond Mottram. Our total time from Sheffield to Guide Bridge was 46¾ min., and our net time 46¼ min. for the 36¼ miles. After a three-minute stop at Guide Bridge, we covered the 8 miles to Chorlton, slacking as usual at Fairfield and Chorlton Junctions, in 10 min. 5 sec., and, despite a signal check beyond the latter station, reached Manchester (Central) in 15 min. 35 sec. from Guide Bridge (11¼ miles), and in 65 min. 10 sec.—actual time—from Sheffield. So we were ¾ min. early, and safely made our Liverpool connection—a result for which the magnificent hill-climbing from Sheffield may be held mainly responsible.

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Locomotive and Train Working in the latter part of the 19th Century.

THE GREAT NORTHERN RAILWAY. [No. I.]

By E. L. AHRONS, M.I.Mech.E., M.Inst.Loco.Eng.

A PASSENGER familiar with the conditions which obtained in 1880, travelling to-day from King's Cross to York or to Leeds by the Great Northern Railway, notices at once three great changes. The first is the doubling of the main line from two to four roads as far north as Stoke tunnel —virtually 100 miles from London. The second is the substitution of the heavy eight and twelve-wheeled corridor stock for the old six-wheeled coaches, to which the Great Northern clung tenaciously long after the Midland had adopted bogie vehicles. Of the above two changes very little need be said beyond giving utterance to an expression of deep thankfulness that the six-wheeled coaches in question are only infrequently seen now on the main line. These vehicles had points of their own not to be found in other companies' similar stock—at least in those of the great lines running north. The backs of the seats were somewhat too vertical to be comfortable, the door handles required a pipe-wrench to turn them, and finally, but by no means least, they were the "hardest-riding" coaches in the country. So much so, that I frequently suspected them of having octagonal wheels. And yet they had to travel at speeds at that time as high or higher than any in the country. They are still to be found "grinding" over the branches, and if any reader is desirous of sampling them, he can try the 4.18 p.m. express from Grantham to Nottingham—unless, as a result of the war, they have since been "improved" off the route—and by the time he has passed Bottesford he will know what I mean.

The third great change, and the one of most interest for the purpose of this article, is the utter and complete disappearance of the old "racers," the well-known "singles" of the late Mr. Patrick Stirling. Prior to about 1898 a coupled engine was very rarely to be seen on a Great Northern express south of Doncaster. There were exceptions, it is true, mainly between Doncaster and Grantham, but as a general principle the "singles" did all the best main line work. Of their melancholy disappearance more will be said later.

The stud of single express engines consisted of three principal types, with a fourth added later from 1885 to 1888. The rebuilt 7 ft. "Sturrocks" were to be seen on certain fast and stopping main line trains. These were generally the Cambridge expresses, and in the late "seventies" the 264 to 269* class stationed at Peterborough, frequently ran the fastest trains both to London and to Leeds. But the day of the once celebrated 203–214 series with 6 ft. 6 in. wheels, was over insofar as main line expresses were concerned, though they were to be found on some of the stopping trains.

Mr. Stirling's 7 ft. singles of 1868 to 1870 took a big share of the fastest trains. They were stationed as follows :—

Peterborough: 4, 21, 39, 41, 63, 222 (and 92.)
Grantham: 14, 37, 61, and 215.
Retford: 6 (and later 41, transferred from Peterborough.
Doncaster: 55.

As is well known No. 92 differed from the others of the class in having 7 ft. 6 in. driving wheels; these wheels had belonged to the old Sturrock bogie single, old No. 215.

As may be expected, the best trains fell to the lot of the celebrated 8 ft. bogie singles. These engines, the first of which appeared in 1870, were not built in batches of ten or more, but came out from time to time from Doncaster works in isolated units, so that at the end of 1876 there were only fifteen of them at work. At the end of 1887 there were 45 of them. They were stationed only at

* In 1877-8 two of these engines, Nos. 265 and 266 were fitted with the Westinghouse brake.

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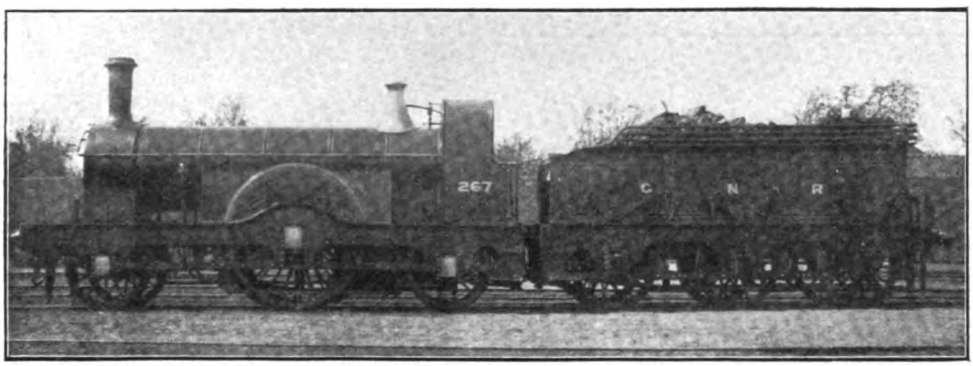
King's Cross, Peterborough, Grantham and Doncaster, their original stations being as follows, in the order of their appearance :—

Shed.	1876-80.	Added 1881-85.	Added 1886-87.
London ..	53, 94, 544, 547*	666, 671, 774	
Peterborough ..	8, 7, 22, 48, 221, 69, 98, 545, 549	663, 668, 772	776
Grantham ..	2, 3, 5, 62, 60, 93, 95	665, 771, 773	775, 777, 778
Doncaster ..	1, 33, 34, 47, 546, 548, 550, 662	664, 667, 669, 670, 547*	

* Transferred from London to Doncaster in the 1881-85 period.

footers" dated from 1870, it was the end of 1875 before London shed stabled one as its own property. This was engine No. 53, the twelfth to be constructed. On some lines—the Midland and Great Western, for example—London generally obtained the first pick of a new class of express engine.

At this period the working of the main-line engines differed considerably from what it is at present. The London engines did not take trains north of Grantham, and the Doncaster engines did not run south of Peterborough, except with occasional specials, so that No. 1 was a very rare visitor to King's Cross. Grantham engines ran southwards to London and northwards to York, but never to Leeds. This latter omission also holds good to-day. Peterborough engines were the only ones that covered the whole of the main line, including London on the one hand, and both



REBUILT 7 FT. STURROCK "SINGLE" ENGINE, ORIGINALLY A 2-4-0 ENGINE.

No. 1001 (Peterborough) and 1002 (Grantham) were added later in 1893.

Unlike the 7 ft. singles, the stations of several of which were subsequently changed, very few of the "eight-footers" were moved about for many years. Nos. 33 and 47 were for a year or two stationed at Leeds, but in 1878 I believe they returned to Doncaster. No. 547 was removed from London in the early eighties, and also went to Doncaster. Other than the two engines mentioned, it is curious that Leeds never had any singles stationed there, though three trains were invariably "horsed" from Leeds by them. More strangely still, York never had the distinction of a single engine until No. 981 (a 7 ft. 6 in.) was sent there in 1894, though they streamed into York station from the south in the afternoons, especially in the summer months. Another interesting point is that although the "eight-Leeds and York on the other; but even this must be qualified by adding that the link which dealt with the Leeds train did not contain an "eight-footer," but was then composed almost entirely of the 7 ft. singles, with an occasional "Sturrock" of the 264 class. The Retford 7 ft. single No. 6 ran daily to Peterborough and back.

In 1885-8 there was added another class, the almost equally celebrated 7 ft. 6 in. singles with inside cylinders, Nos. 229 to 240. These were stationed with the "eight-footers" and took their turns on the same trains. It does not seem to have occurred to the Great Northern locomotive authorities of those days that it might possibly have been advantageous to have kept the whole of the one class at one shed, instead of mixing them up with the "eight-footers."

The 229 to 240 class had inside cylinders 18½ in. by 26 in. They were stationed as

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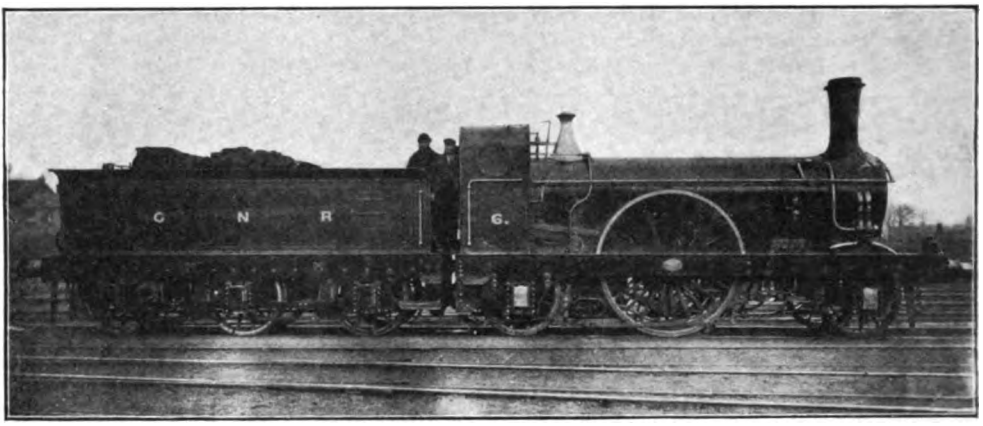

STIRLING 7 FT. "SINGLE" LOCOMOTIVE NO. 6, WITH ORIGINAL FORM OF CAB.

in the subjoined table. Of the eleven engines of the class which were built in 1892–4, Nos. 871 to 875 were originally constructed with 18 in. cylinders.

Shed.	1885–88.	Added 1892–94.
London ..	230	872, 873, 877, 879
Peterborough	234, 237, 233	874, 875
Grantham ..	231	871, 878, 880
Doncaster ..	238, 232, 236, 239, 240	876
York ..		981

York was supplied with a few of the Stirling four-coupled 2–4–0 passenger engines, Nos. 281, 282, 86, 207, 223, 541 and 700, which usually worked to Doncaster, and with one if not two trains daily to Grantham. These were fast trains, but the Scotch expresses both day and night, were invariably taken into and out of York by singles from Grantham or Peterborough, and in the case of one train by a Doncaster engine.

Leeds, with the exception of the short period in the 'seventies when the two "eight-footers" Nos. 33 and 47 were stationed there, was also provided with the same type of 2–4–0 engine. These were Nos. 285, 290, 299, 261, 540 and 72. Later No. 51 joined them in the early 'eighties, and there was also *old* No. 224, a double-framed rebuilt Hawthorn as spare engine. As one of the others was generally in the shops, 224 was to be seen regularly taking her turn on the expresses. When it was broken up about 1886, the new 224 (Stirling's 2–4–0) took its place, together with No. 758, then a new engine.

With the exception of three trains, the whole of the express and passenger service between Leeds and Doncaster was performed by these Leeds engines. I believe they worked one train as far as Retford, but with this exception they came off at Doncaster. The two London expresses, the 9.0 a.m. and 10.0 a.m. from Leeds, were always worked by Doncaster eight-foot singles, which had worked down with early morning stopping trains. Finally there was the evening 5.30 p.m. London express, horsed by one of the Peterborough 7 ft. singles, generally of the No. 4 class; but No. 92, the 7 ft. 6 in., and occasionally some of the 264 to 269 series, took their turns on this train. I never saw an "eight-footer" on it until the end of the 'eighties.

I cannot call to mind the date when the engine working began to change, but it was subsequent to the putting on of the through runs without stopping between London and Doncaster. The first train to perform this run was, I believe, the 9.45 a.m. from King's Cross, which for a time was worked by Grantham "singles." Now the London engines work not only to Doncaster, but with one train, the 7.15 a.m. from King's Cross, the London Atlantic works through to Leeds, and returns with the 2.0 p.m. express, which has the non-stop run of 175¾ miles from Wakefield to London.

Having given a general review of the main line locomotive working of that day, it is now time to turn to the train services and speeds. There were, as now, three distinct sets of main line expresses (*a*) Scotch to York, (*b*) Leeds and Bradford, (*c*) Manchester *viâ* Retford.

The "Flying Scotchman"—the 10.0 a.m. from King's Cross—was popularly supposed to be the fastest train, though as a matter of fact its actual speed was below that of the

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Manchesters, and of one or two of the crack Leeds expresses. This train during the early 'eighties was timed to run the 105¼ miles to Grantham in 2 hours 9 min. My only record with it is of 8 ft. single No. 666 and 10 coaches weighing about 150 tons. The 13th post just north of Potter's Bar was passed in 21 min. 42 sec., the minimum speed between mileposts being only 36·7 miles per hour, a rather mild performance; but the 59 miles from post 16 to post 75 (1¼ miles south of Peterborough) were reeled off in 60 min. 17 sec., a sustained speed of 58·7 miles per hour, the maximum speed being 70·6 miles per hour at the 36th post.

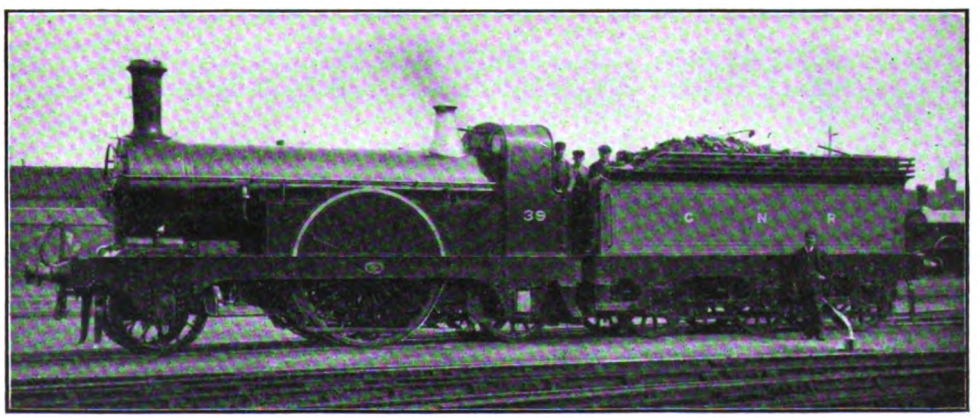
Peterborough was passed slowly in 87 min. 17 sec. from the start, and the uphill climb from post 80 to post 100 (Stoke tunnel) took 26 min. 21 sec., an average of 45·4 miles per hour, with a minimum at the summit of 36 miles per hour. Grantham was reached in 2 hours 6 min. 46 sec. from the start, a gain of almost 2¼ min. It is obvious from this that the driver had no need to thrash his engine up to Potter's Bar as he knew that he could easily do the required running beyond that point.

Beyond Grantham the 10.10 a.m. from King's Cross was taken, and this incidentally gave me my only preserved record of a run behind one of Stirling's 7 ft. singles. This was No. 55, the cylinders of which were 17½ in. by 24 in., and the pressure 140 lbs. For a small engine with a load of 180 tons, the run was distinctly good. From the 110th post to the 124th post—14 miles—took 13 min. 35 sec., an average of 61·8 miles per hour. Retford, 33¼ miles from Grantham, was reached in 40 min. 32 sec., but there was one signal slack outside Retford, which caused a loss of about 1½ min. In spite of this the engine gained 1 min. 28 sec. from Grantham. As this run possesses several features of interest, it may be given in full as follows:—

No. 55, 7 ft. 2-2-2 single, 17½ in. by 24 in. Load 180 tons.

			H. M. S.	M.P.H.
Grantham (105¼)	..	dep.	0. 0. 0	—
Milepost 106	..	pass	0. 2.20	—
,, 107	..	,,	0. 4. 0	36
,, 109	..	,,	0. 6.42	44·4
,, 110	..	,,	0. 7.48	54·5
,, 111	..	,,	0. 8.47	61
,, 112	..	,,	0. 9.46	61
,, 113	..	,,	0.10.42	64·3
,, 114	..	,,	0.11.38	64·3
,, 115	..	,,	0.12.37	61
,, 116	..	,,	0.13.33	64·3
,, 117	..	,,	0.14.29	64·3
,, 118	..	,,	0.15.26	63·2
,, 119	..	,,	0.16.26	60
Newark	..	,,	0.17.26	—
Milepost 121	..	,,	0.18.22	62·1
,, 122	..	,,	0.19.21	61
,, 123	..	,,	0.20.22	59
,, 124	..	,,	0.21.23	59
,, 125	..	,,	0.22.25	58·1
,, 126	..	,,	0.23.27	58·1
,, 127	..	,,	0.24.31	56·2
,, 128	..	,,	0.25.36	55·4
,, 129	..	,,	0.26.43	53·7
,, 130	..	,,	0.27.57	48·6
,, 131	..	,,	0.29.20	43·4
,, 132	..	,,	0.30.47	41·4
,, 133	..	,,	0.32.10	43·4
,, 134	..	,,	0.33.34	42·8
,, 135	..	,,	0.34.50	47·4
,, 136	..	,,	0.35.55	55·4
,, 137	..	,,	0.36.58	57·1
,, 138*	..	,,	0.38.9	50·7
Retford (138½)	..	arr.	0.40.32	—

* Signal check at 137¾ post; very slow into Retford from 138th post; 1½ min. lost by signals. Left Grantham 2 min. 34 sec. late; arrived Retford 1 min. 6 sec. late.



STIRLING 7 FT. "SINGLE" LOCOMOTIVE NO. 39.

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STIRLING 8 FT. "SINGLE" LOCOMOTIVE NO. 8 (1870).

The fastest York train in the early 'eighties was the 1.15 p.m. down from King's Cross, which reached York ticket platform at 5.17 p.m. This train ran to Peterborough at 50·8 miles per hour, Peterborough to Grantham at 46 miles per hour, and Grantham to Doncaster at 52¼ miles per hour.

In July, 1888, the year of the first Scotch train racing, the 10.0 a.m. had been quickened up to 2 hours 4 min. from London to Grantham, and 1 hour 36 min. from Grantham to York, and in August a further acceleration took place which reduced the London-Grantham timing to 1 hour 57 min., and the Grantham-York run to 1 hour 28 min. for the 82¾ miles. On August 31st the run to Grantham was done in 110 min. (57½ miles per hour) and the Grantham-York section in 87¾ min., but with a dead stop at Selby of 2 minutes for signals.

I had no personal experiences of these racing trains, but I find a record that the 7 ft. 6 in. single No. 233 on August 25th covered the 105¼ miles to Grantham in 105 min. I believe the Grantham to York record was made by No. 775, an 8 ft. single. The trains were, however, very light.

Before leaving the York trains mention may be made of the record prior to the 1888 racing. On July 31st, 1880, the Lord Mayor of London went to York. Why he went, and what he did when he got there, I do not know, but he travelled in state by special train.

On this occasion engine No. 94 (8 ft.) passed Peterborough after an average run of 54 miles per hour, Stoke signal box at 50 miles per hour from Peterborough, and arrived at Grantham in 2 hours 0½ min. from London. No. 95 took the train on to York at 57 miles per hour, including the then usual slowings through Retford, Doncaster and Selby. The Retford slack does not exist now, and Doncaster is always run through at a much higher speed than was formerly the case. These points should be borne in mind when comparing present day runs with those of former years.

The most phenomenal Leeds and Bradford expresses of the period with which I have to deal were the two down and two up Leeds trains of the summer of 1880, which completed the journey in 3¾ hours. The down trains were the 3.45 and 6.30 p.m. from London, with corresponding up trains

STIRLING 7 FT. 7½ IN. "SINGLE" LOCOMOTIVE NO. 238 (1885).

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leaving Leeds at 9.15 a.m. and 2.30 p.m. The timing of the former up train was Leeds dep. 9.15; Wakefield arr. 9.30, dep. 9.32; Grantham arr. 10.53, dep. 10.57; King's Cross arr. 1 p.m.

These trains were the reply of the Great Northern to the then new Midland "John Noble" expresses *viâ* Nottingham, and made their appearance on June 14th, 1880. In July the timing of the down trains was modified to give rather more time for the climb from Peterborough to Stoke tunnel. Three min. was taken off the Grantham to Wakefield run, which was now performed in 77 min. for the 70¼ miles, an average of 54¾ miles per hour, including the slacks through Retford and Doncaster.

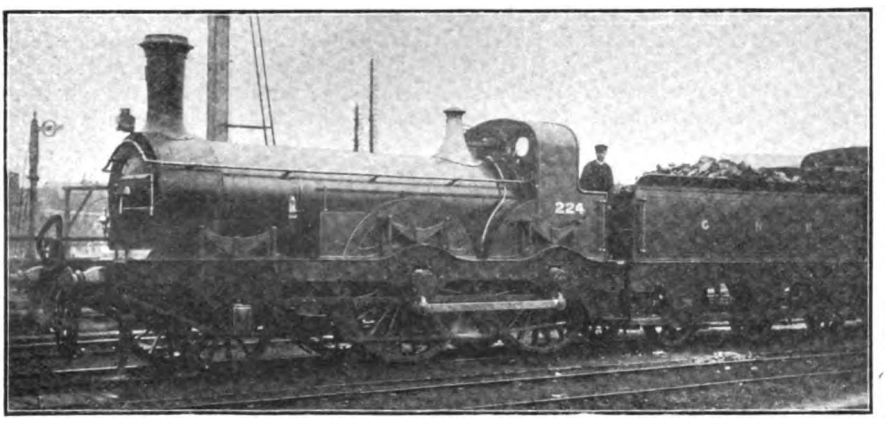
Between Leeds and Grantham, Doncaster 8 ft. singles were used, and the train due at King's Cross at 1 p.m. was generally run by No. 93 of Grantham, which engine worked the corresponding down train leaving London at 3.45 p.m. The load would be about seven or eight six-wheeled coaches (including two from Bradford) between Wakefield and London.

The older crack 10 a.m. up express from Leeds was worked to Grantham by a Doncaster 8 ft. single, whence it was taken on to London by the London "eight-footer" No. 53. This engine had a monopoly of this work for a long period from the year 1876. No. 53 was the first of the class to be stationed in London, and it was stated that it was sent there specially for this train. On the down journey No. 53 took the morning express corresponding to the present 7.15 a.m. from King's Cross.

I had three journeys on this train, when the engine was always No. 53, but they were made before I took any timing records. I have, however, one record of this celebrated old "racer" on another train some years later, with a load of only 90 tons. From Grantham to passing Peterborough took 32 min. 20 sec. for the 29 miles, which, of course, includes the 5-mile uphill pull from Grantham to Stoke tunnel, mostly 1 in 200 from the dead start. From the 98th post to the 79th post, 19 miles, we took 17 min. 13 sec., the maximum speed for 2 miles, 93rd to 91st post, being 72 miles per hour. From Peterborough (pass) to New Barnet (pass), after which we encountered several signal checks, No. 53 took 73 min. 45 sec. for the 67¼ miles, the maximum not exceeding 64½ miles per hour.

Another run with one of the down Leeds expresses was with the 8 ft. engine No. 7 and a load of 170 tons. The 13th post from King's Cross was passed in exactly 21 min. from the start, but after reaching 63¼ miles per hour at the 19th post, No. 7 fell off somewhat badly to 46 miles per hour at the 24th, but from post 30 to post 49 the 19 miles were covered in 18 min. 24 sec. A maximum of 67·9 miles per hour was reached later at the 68th post, but for some unaccountable reason half a minute was dropped to Peterborough, a very unusual event with the 8 ft. singles in those days. It should, however, be stated that this run was in winter and the weather was moderately bad. The run to Peterborough was done in exactly 88½ min.

One other instance with a Leeds express shows an average sample of the performance of the 2–4–0 coupled engines. The one in



STURROCK 6 FT. 6 IN. 2–4–0 LOCOMOTIVE (17½ IN. × 24 IN. CYLS.) AS REBUILT.
Originally built by R. & W. Hawthorn in 1855.

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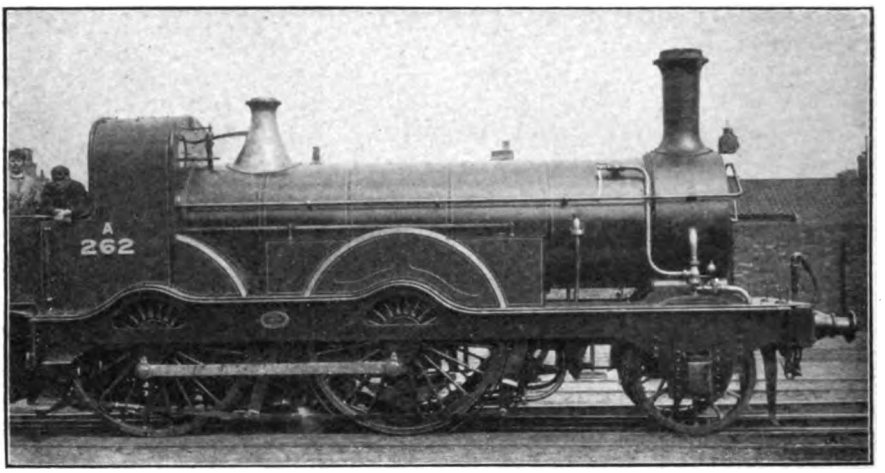

STIRLING 6 FT. 7½ IN. 2-4-0 LOCOMOTIVE NO. 262.
Placed on the "A" list in 1901.

question was No. 207—a York engine—with 6 ft. 7½ in. wheels and 17½ in. by 26 in. cylinders, and 140 lbs. pressure. Retford to Newark (18½ miles) was covered in 23 min. 58 sec., and Newark to Grantham (14¾ miles) in 21 min. 20 sec. I have mentioned this somewhat ordinary instance because the coupled engines were rarely to be found on the express trains, and then only north of Grantham. But the first portion of the run from Retford is chiefly noteworthy for the slow speed at which No. 207 ascended the Retford bank of 1 in 200 (posts 139 to 134½) with a load of about 180 tons. From the start (138½) to the 133rd post required 10 min. 3 sec. Afterwards 207 tried to make up for it by running from post 131 to post 124, 7 miles, in 6 min. 44 sec., reaching a maximum of 66·7 miles per hour at the 128th post.

Mr. Stirling always maintained that the "singles" climbed the banks better than the coupled engines, and the above run, which is a fair sample of my other Great Northern experiences, would appear to bear out his contention. But I am afraid that the celebrated old engineer never gave his coupled engines enough boiler power, though on the other hand it must be admitted that his "singles" were in like case. Certain it is, however, that the Stirling coupled engines never seemed to give a good account of themselves on a fast train, whereas some of the performances of the singles made one wonder how they managed to do them.

(To be continued.)

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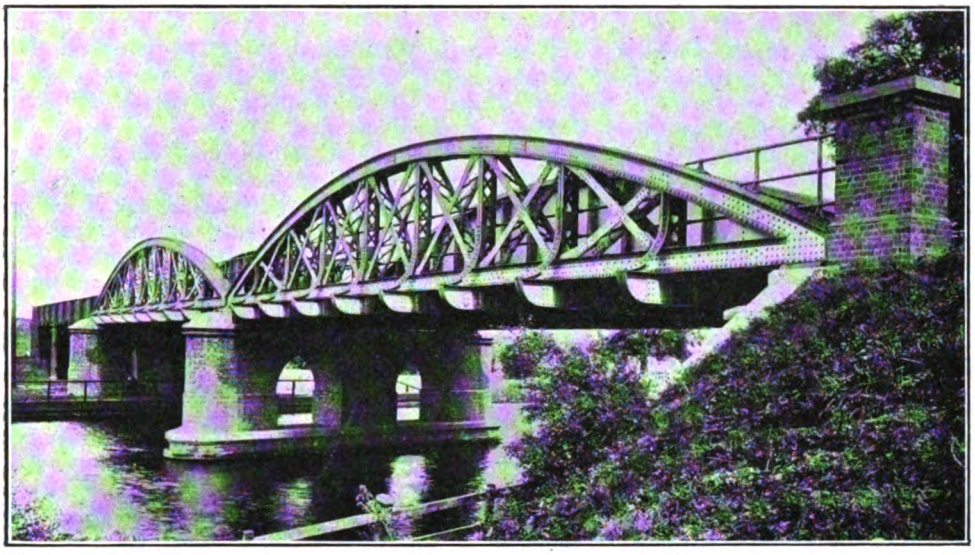

NUNEHAM BRIDGE, DIDCOT-OXFORD SECTION, GREAT WESTERN RAILWAY.

The Progress of the Great Western Railway from Oxford to the Mersey. [No. I.].

By HERBERT RAKE.

ALTHOUGH the Great Western Railway was commenced primarily to connect London with Bath and Bristol, at an early period extensions towards the north were taken in hand, these eventually constituting in effect virtually an independent system of main lines and branches. These extensions were, however, projected as more or less independent railways, and it will be most convenient to deal with them geographically, considering the respective sections in order.

A. From Didcot to Oxford.

Originally it was intended that the Oxford branch should commence at Steventon (from which point at that time coaches started for Bath, Bristol, etc.) on the Bristol main line, thence passing through Abingdon; but the short-sighted opposition of the Abingdon residents drove the railway eastwards to Didcot, which became the starting point of the Oxford branch and necessitated the Thames being crossed twice, first by a bridge about two-thirds of a mile south of Culham station, and secondly by the Nuneham viaduct. The latter bridges the river at the west end of Nuneham Park, and was originally a timber structure, replaced in 1849–50 by an iron-plate girder bridge, and again by the present structure, opened on March 16th, 1907.

On June 12th, 1844, this extension was opened for public traffic. At Oxford, the College authorities insisted that the line and station should be kept as far away from the City as possible, and the railway company (according to a weekly periodical of the period) purchased from the Freemen of the City 4 acres 26 poles of a portion of Port Meadows, "and the worst part of it," for £1,284.

B. The Oxford and Rugby Railway.

The next link was the Oxford and Rugby Railway, though as this never reached the latter town its title was not altogether justified. Initial steps for its promotion were taken at a meeting held in Oxford on May 14th, 1844. This was attended by two of the Directors of the Great Western Railway Company, together with Mr. Brunel, the Engineer, and Mr. Saunders, the Secretary. Several influential members of the University

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were also present, together with the Mayor and other "respectable inhabitants" of the City.

The proposal was to extend from Oxford to Banbury, and thence in the direction of Rugby or Worcester. A railway to the north leaving the proposed Oxford and Rugby line near Fenny Compton and thence passing through Leamington and Warwick and so to Birmingham was also suggested. Mr. Brunel endorsed the proposal that the railway should run to Birmingham instead of Rugby, and he emphasised the fact that the distance from London to Birmingham by this route would be only 12 miles longer than by the existing London and Birmingham Railway.

A considerable discussion ensued, but finally a resolution was carried in favour of a line from Oxford to Rugby, a distance of

SEAL OF THE OXFORD AND RUGBY RAILWAY.

SEAL OF THE BIRMINGHAM, WOLVERHAMPTON AND DUDLEY RAILWAY.

50½ miles. In due course, therefore, an Act was obtained in August, 1845 (8 and 9 Vict. Cap. 188) and work was commenced in the autumn of that year. On September 30th, 1850, the line was opened to Banbury, the extension to Fenny Compton being opened on the same date as the Birmingham and Oxford Junction Railway, which will be referred to in due course. The Rugby line was never proceeded with beyond Fenny Compton, for reasons which will duly appear.

C. The Birmingham and Oxford Junction Railway.

During the year 1845 a project known as the Birmingham and Oxford Junction Railway was mooted under the auspices of the Great Western and Grand Junction Railways. The latter company were at that period on bad terms with the London and Birmingham Railway, and desired to obtain an independent access to London, which they hoped to do by way of the proposed railway and Great Western lines already constructed.

The London and Birmingham Railway at this time had projected a line from Northampton to Banbury, together with an extension of the Coventry and Warwick line to Nuneaton. They also proposed, in conjunction with the Midland Railway, to construct a line from Hampton-in-Arden to Warwick and Leamington and thence to Banbury. In addition an arrangement had been made with the Birmingham Canal Company, and the projected Shrewsbury and Birmingham Railway, for a line extending from Birmingham to Wolverhampton.

This threatened intrusion by the Great Western Railway into a district which had become in large measure a kind of preserve of the London and North Western Railway, resulted in a policy of *lex-talionis*, and notices were issued for a line from Tring *vid* Aylesbury and Bicester, throwing out a branch to Oxford and proceeding through the valley of the Cherwell to Worcester, whence it was hoped to reach Wolverhampton. Of this more anon.

Returning to the proposed Birmingham and Oxford line, it was intended that this should leave the Oxford and Rugby Railway near Fenny Compton, passing through Leamington (then served only by a branch from Coventry) and thence by way of Warwick and Hatton Junction to Birmingham. Fares from London to Birmingham were to be fixed at a maximum of 20s. for first-class and 15s. for second-class passengers, the time occupied in the journey to be 3 hours.

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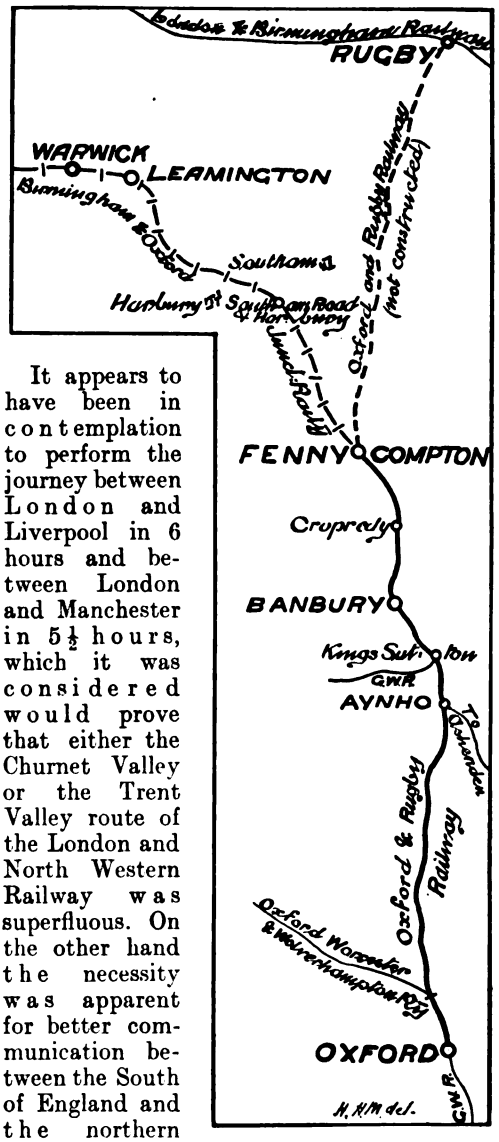

MAP SHOWING OXFORD AND RUGBY AND BIRMINGHAM AND OXFORD JUNCTION RAILWAYS.

It appears to have been in contemplation to perform the journey between London and Liverpool in 6 hours and between London and Manchester in 5½ hours, which it was considered would prove that either the Churnet Valley or the Trent Valley route of the London and North Western Railway was superfluous. On the other hand the necessity was apparent for better communication between the South of England and the northern districts; and it was thought that the proposed route would strongly commend itself on this account.

Naturally the scheme provoked the fiercest opposition, not only from the London and Birmingham Railway, but also from the Birmingham Canal Company, as well as other vested interests, and the Bill was thrown out; but it seems to have been covertly intimated that it might be re-introduced. Accordingly a special meeting of the scripholders was held at Birmingham on May 13th, 1845, for the purpose of assenting or dissenting from the further progress of the Bill. It was stated at this meeting that the necessity for the railway was universally admitted, and so far as the line to Dudley was concerned that the London and Birmingham Company themselves had admitted that an additional line was required for the proper accommodation of the district. A resolution was accordingly carried in favour of proceeding with the Bill in the next Session of Parliament, together with a further Bill for making a railway into Birmingham as an extension of the proposed Birmingham and Oxford Junction Railway. Both these measures received Royal Assent on August 3rd, 1846 (9 and 10 Vict. c.c. 337 and 338), and under these Acts authority was given to raise a capital of £700,000 and to borrow £233,330, while another Act of the same Session gave powers to raise an additional capital of £300,000. The original Act provided that the shareholders should be empowered to lease their line to the Great Western Railway in the event of three-fifths of the shareholders signifying that they were in favour of so doing.

The London and Birmingham Railway had by this time become an integral part of the London and North Western Railway, who were not slow in availing themselves of the opportunity that this clause presented to obtain possession of the competing line, and they thereupon commenced to purchase as many shares as they could procure on behalf of their appointed nominees, who then petitioned the former company to purchase the Birmingham and Oxford line. But meanwhile the *bona fide* shareholders had ratified an agreement dated November 12th, 1846, entered into by their Directors, to sell to the Great Western Company, though at a considerable lower figure than was now offered by the London and North Western Company. Much dissatisfaction was expressed at what was considered the precipitate action of the Directors, and the malcontents, together with the nominee shareholders, convened a special meeting, where the number of Directors was increased from 12 to 18, the six new ones appointed being in favour of selling to the London and North Western Company.

At the following general meeting four of the original Directors were due to resign, but refused to tender their resignations on it becoming known that the four new names to be submitted were nominated by the partizans of the London and North Western

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Railway, who it was discovered already held four-fifths of the capital. The whole matter was then brought before Parliament, and eventually the Great Western Company obtained a judgment confirming the lease to them, and declaring the six extra Directors to have been illegally elected. An Act was accordingly obtained in conformity therewith dated August 31st, 1848.

At a special general meeting of the shareholders held in 1847 the expediency of amalgamating with the Birmingham, Wolverhampton and Dudley Railway was discussed, it being maintained that the only reasons which had been urged in favour of the union were that it would advance the broad gauge and thus serve the purposes of the Great Western Railway. It was pointed out, moreover, that the Birmingham and Oxford line passed through a sparsely populated district, while the Dudley and Wolverhampton line intersected a busy manufacturing and iron district, whose traffic would be simply poured upon their line if the two were amalgamated. At length a resolution was carried, with various dissentients, that the Directors should be authorised, in conjunction with the Birmingham, Wolverhampton and Dudley Railway, to apply to Parliament in the next Session for Acts to carry into effect the amalgamation with the Birmingham and Oxford Junction Railway, provided that the Acts contained a power to dispose of the lines when amalgamated to the Great Western Railway, and that the Directors be thereby requested to negotiate with the latter company for some arrangement to that end.

The contract for the construction of the first portion of the Birmingham and Oxford Junction line from near Fenny Compton was let early in 1847, and operations were at once commenced, it being understood that the line would take two years to complete. Messrs. Peto & Betts were the contractors, under the superintendence of Mr. I. K. Brunel.

The Harbury cutting, between Southam Road and Harbury station and Leamington, was then taken in hand. This is about half-a-mile long and 110 ft. deep, and involved the excavation of some 3,000,000 cubic yards of marl and limestone, which was used in forming an embankment, immediately beyond, 4 miles in length and of an average height of 23 ft. Whitmarsh cutting, out of which there was taken 35,000 cubic yards of red marl, was the next important part of the work, and was followed by the viaduct at Leamington and the bridge over the High Street, the latter having a span of 130 ft. At Myton an aqueduct was constructed to carry the Birmingham and Oxford Canal over the railway. Other works involved were a bridge over the River Avon, 160 ft. long; a viaduct at Warwick of 30 arches, each of 25 ft. span; an iron girder bridge over the road and Canal at Warwick of 150 ft. span; the Hatton embankment, 3 miles long and 25 ft. high; the Hatton cutting, out of which was taken 500,000 cubic ft. of earthwork; the Finwood Bridge, 50 ft. high and 140 ft. long; an iron bridge over the Stratford Canal, 60 ft. long; the Blythwood embankment, 1 mile long and 40 ft. high; the Solihull viaduct, 500 ft. long, over the reservoir at that place; an embankment at Acock's Green, 1 mile long and 48 ft. high; the Acock's Green cutting,

LEAMINGTON STATION, BIRMINGHAM AND OXFORD JUNCTION RAILWAY.
(From *The Illustrated London News*, October 16th, 1852.)

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1 mile long and 30 ft. deep; a bridge under the Bristol and Gloucester Railway; an iron bridge over the Warwick Canal, 150 ft. long; and a bridge 60 ft. long, over the Coventry road into Birmingham. Some of the stations were of pleasing design, that at Leamington being a good specimen. They were designed by Mr. T. H. Bertram, the Resident Engineer.

This line, along with that part of the Rugby and Oxford Junction Railway between Fenny Compton and Banbury, was opened on September 30th, 1852. At the opening ceremony one of the carriages used was an eight-wheel composite carriage, carrying 24 first-class and 56 second-class passengers, the first-class compartments being in the centre with 2 second-class compartments at each end. The length of the body was 38 ft. and the width 9 ft. 9 in. The framework was entirely formed of wrought iron, the sides being trussed and stayed with light rods. The wheels were in sets of two pairs, 5 ft. apart in the centres.

CUTTING AT HARBURY, BIRMINGHAM AND OXFORD JUNCTION RAILWAY.
(From *The Illustrated London News*, October 16th, 1852.)

D. The Birmingham, Wolverhampton and Dudley Railway.

The importance of securing uninterrupted communication without break of gauge between Wolverhampton, Birmingham and London, in view of the union with the Birmingham and Oxford Junction Railway, demonstrated the urgency of applying to Parliament for powers to make a line by way of West Bromwich and Wednesbury to Priestfield Junction, there joining the Oxford, Worcester and Wolverhampton Railway. A Bill was accordingly presented to Parliament during 1845, to which Royal Assent was given on August 3rd, 1846, conferring power to raise capital to the amount of £700,000 and to borrow £233,333. On July 9th, 1847, the company obtained an amending Act authorising the raising of an additional capital of £50,000, with further borrowing powers to the extent of £16,666.

The original Act also authorised the construction of a branch from Swan Village, near West Bromwich, to Great Bridge, on the South Staffordshire Railway (now part of the London and North Western Railway), with running powers over the latter line to Dudley.

In 1846 the Board of Trade determined to exercise their powers in respect of the broad gauge lines sanctioned by Parliament, from Oxford to the north and north-west, and they ordered that the mixed gauge should be introduced. This order compelled the Birmingham, Wolverhampton and Dudley Company to lay down their permanent way with a triple line of rails.

About the same time it had been proposed to apply for a line from Smethwick Junction, between Handsworth and West Bromwich, to Stourbridge. This line, which did not

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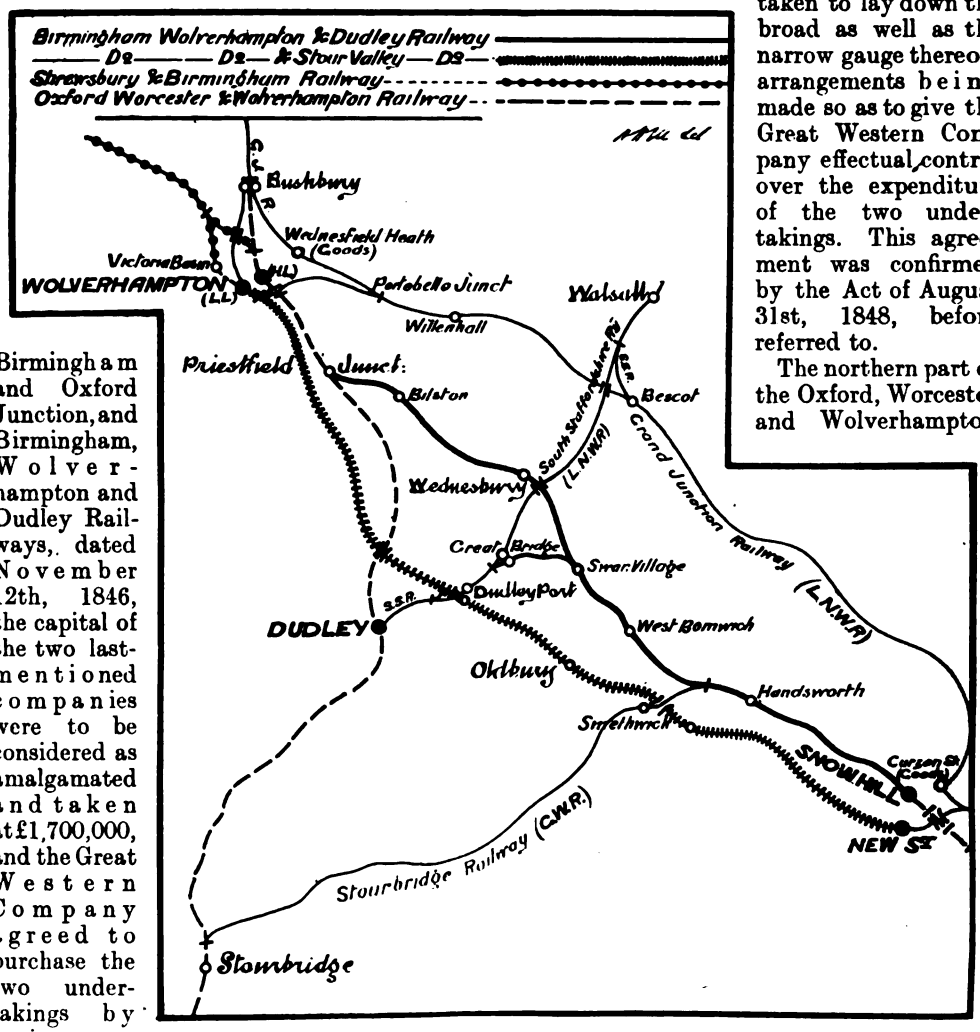
obtain its Act until 1860, was constructed by a separate company. It was opened throughout on April 1st, 1867, but was worked at first by the Oxford, Worcester and Wolverhampton Railway, and thereafter by the Great Western Railway until incorporated in the latter at a later date.

Under the terms of the agreement before referred to between the Great Western, the Birmingham and Oxford Junction, and Birmingham, Wolverhampton and Dudley Railways, dated November 12th, 1846, the capital of the two last-mentioned companies were to be considered as amalgamated and taken at £1,700,000, and the Great Western Company agreed to purchase the two undertakings by paying a premium of £10 5s. on each £20 share, this premium being payable within six months after the completion of the lines. If the railways were not completed by January 1st, 1850, the premium was to be considered due at that date and interest paid thereon until the premium became payable, and should the Great Western Company require the opening of any portion of the line previous to the whole works being completed, then the premium should become due within 6 months after such partial opening, just as if the whole line had been completed. The Birmingham and Oxford Junction, and the Birmingham, Wolverhampton and Dudley were to be amalgamated and powers taken to lay down the broad as well as the narrow gauge thereon, arrangements being made so as to give the Great Western Company effectual control over the expenditure of the two undertakings. This agreement was confirmed by the Act of August 31st, 1848, before referred to.

The northern part of the Oxford, Worcester and Wolverhampton Railway was opened through Priestfield Junction to Bushbury Junction, where it connected with the London and North Western Railway, in May, 1852; and the Birmingham and Wolverhampton line was opened to Priestfield in November,



MAP OF (1) BIRMINGHAM, WOLVERHAMPTON AND DUDLEY, (2) BIRMINGHAM, WOLVERHAMPTON AND STOUR VALLEY, (3) SHREWSBURY AND BIRMINGHAM, AND (4) OXFORD, WORCESTER AND WOLVERHAMPTON RAILWAYS.

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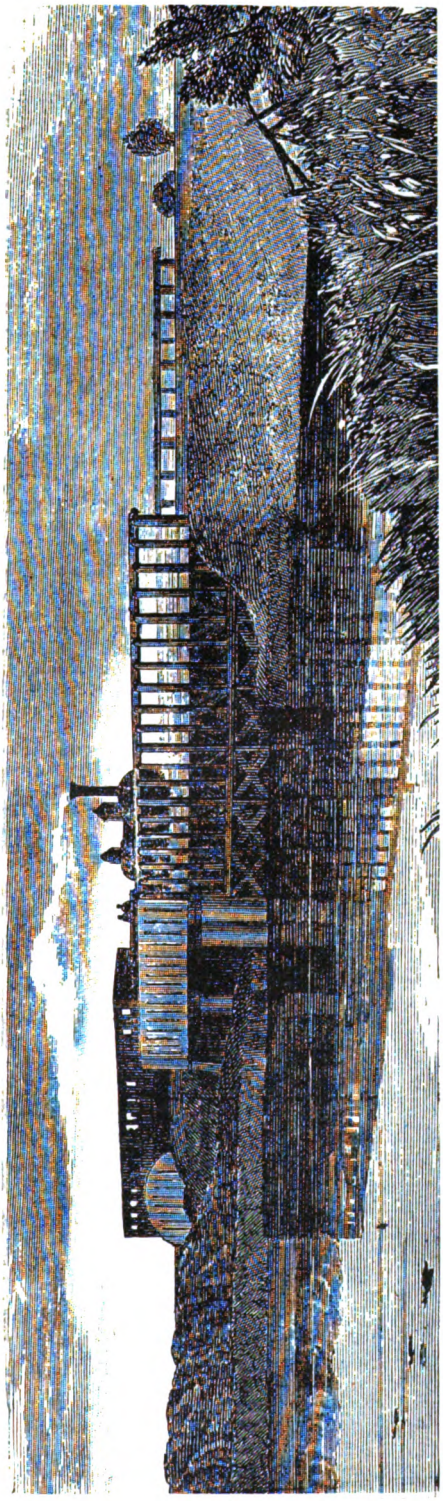

BRIDGE OVER THE RESERVOIR AT SOLIHULL.
(From *The Illustrated London News*, October 16th, 1852.)

1854, from whence Oxford, Worcester and Wolverhampton metals were used to Wolverhampton (Low Level) station, this being the authorised terminus of the broad gauge system.

On September 30th, 1852, contemporaneous with the Birmingham and Oxford Junction line to Leamington as already mentioned, the complete route was brought into use, the event being duly celebrated at Leamington, in the fashion usual in those days, on the arrival of the special train conveying invited guests from Birmingham.

E. The Shrewsbury and Birmingham Railway.

Towards the end of the year 1842 a project was conceived to connect Shrewsbury with Wolverhampton, there to join the Grand Junction Railway, but during the following year it was decided to construct an independent line through to Birmingham. The London and Birmingham Railway then offered to lease the undertaking and work it as an extension of their own line, they foreseeing that with a continuation to Chester (where a connection would be made with the Chester and Birkenhead Railway) it would give a shorter route between Birmingham and the north than *viâ* the Grand Junction Railway through Stafford. It would also serve to lessen the distance from Euston over the proposed route to Ireland *viâ* the Chester and Holyhead Railway.

The leasing of the Shrewsbury and Birmingham Railway became the subject of much contention, especially between the London and Birmingham and Grand Junction Railways. Pressure was, therefore, brought to bear on the promoters of the Shrewsbury line to agree to stop at Wolverhampton and arrange with the Grand Junction to run over their line to Birmingham. But the evident intention was to utterly extinguish the Shrewsbury and Birmingham Railway, and then induce the subscribers to become shareholders in the proposed Shrewsbury and Stafford line of the Grand Junction Railway. This provoked a meeting at Wolverhampton to demand that the original scheme for a competing line between Wolverhampton and Birmingham be carried out.

On October 8th, 1845, a meeting of the subscribers was held at Shrewsbury

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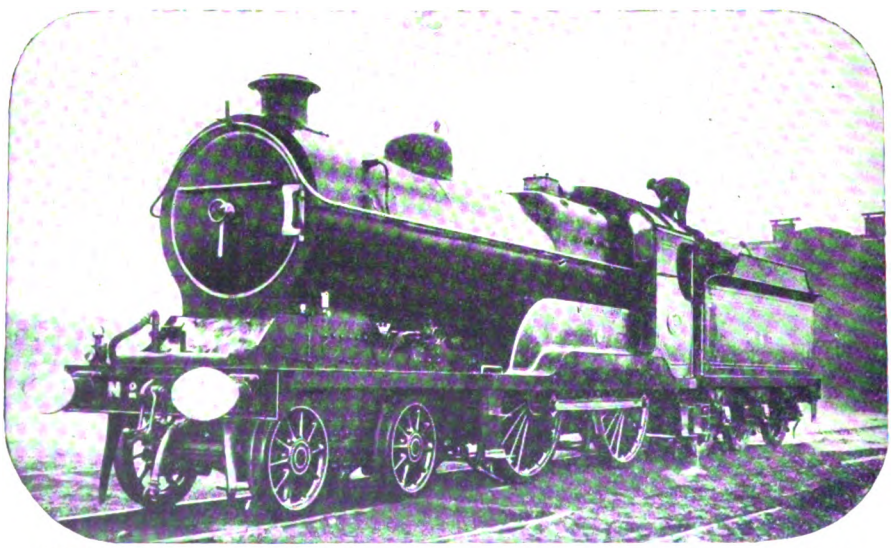
to receive the report of a provisional committee, who reported that by a union of interests with the London and Birmingham Railway and the Birmingham Canal Company they had been enabled to obtain a better and cheaper railway than that originally planned. This portion of the main line would, therefore, be constructed (subject to approval of the subscribers) along the banks of the Canal, with a branch line diverging at Oldbury and proceeding to Dudley, and afterwards rejoining the "Canal" or main line near Tipton, the whole being managed by a joint committee of the three companies interested.

The original Act incorporating the line received Royal Assent on August 3rd, 1846 (9 and 10 Vict. Cap. 307). This also authorised a branch to Coalbrookdale. By an Act granted on the same date the Shrewsbury and Wolverhampton and South Staffordshire Junction Railway was at the same time incorporated and amalgamated with the Shrewsbury and Birmingham Railway. The capital authorised to be raised was fixed at £1,300,000, with power to borrow £433,333.

As originally planned the railway was intended to run from Shrewsbury *viâ* Wellington to Wolverhampton, and thence *viâ* Oldbury and Smethwick into the London and North Western station at Birmingham, the section of line between Wolverhampton and Birmingham being executed under the separate powers of the Birmingham, Wolverhampton and Stour Valley Railway at the joint expense of the London and North Western and Shrewsbury and Birmingham Companies. Under the latter company's Act power was given to make a diversion of their line near Wolverhampton to join the Oxford, Worcester and Wolverhampton Railway at a point 44 chains north of the present Great Western Wolverhampton station, which, under an Act passed in 1848, was to be constructed jointly by the Shrewsbury and Birmingham, Oxford, Worcester and Wolverhampton, and Birmingham, Wolverhampton and Dudley Railways.

(To be continued.)



Photo] [*W. H. C. Kelland.*

GREAT CENTRAL RAILWAY.

4-4-0 superheater locomotive No. 433, *Walter Burgh Gair*, at Neasden.

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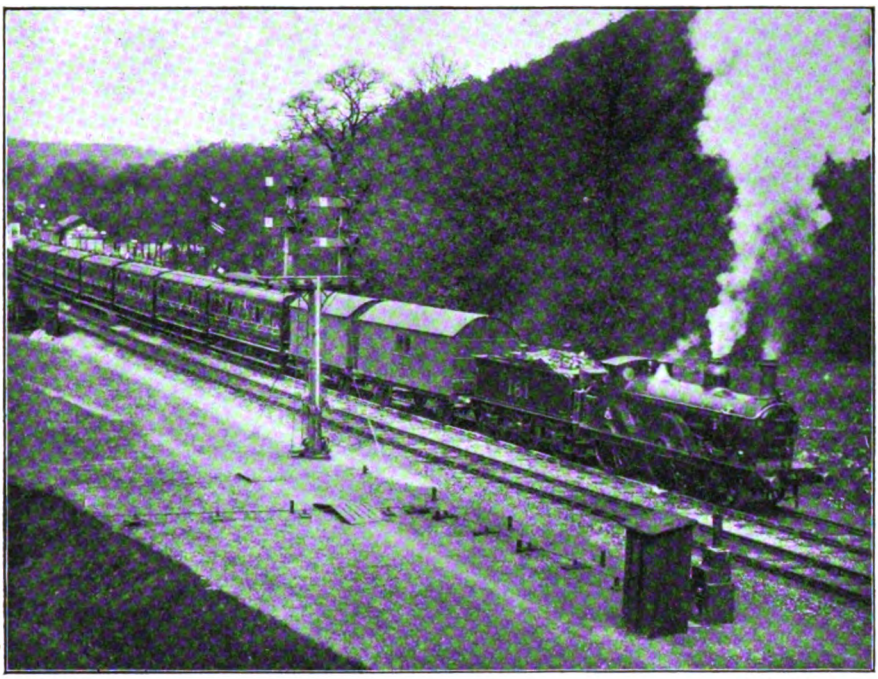

Photo] [*E. S. Hallett.*

1.0 P.M. TRAIN *ex*-SHEFFIELD LEAVING DORE STATION.

The Midland Railway in Derbyshire.

By E. S. HALLETT.

AS a county Derbyshire is not overrun by railways, except in the southern and coalfield areas where industrial requirements have necessitated the construction of many lines, some of them principally important on account of coal and like traffic ; but a large proportion of this mileage, including most of that owned by the Midland Railway Company north of Derby, and nearly all of the London and North Western and North Staffordshire lines within the boundaries of Derbyshire, pass through country which is characterised by wonderful scenic attraction, and which possesses a wealth of historic, antiquarian, archæological, geological and natural interest. Speaking generally, there are two main portions of this scenic area, the more southerly section comprising the Matlocks, Dovedale, Bakewell and district, with, further north, Buxton and the Peak district proper. The beauties of these districts are too well-known to require setting forth here, and the mere mention of these names is sufficient to indicate what Derbyshire has to provide in the way of natural and tourist interest. And to all the principal centres good railway access is provided by the three railways mentioned, the respective lines themselves being characterised by scenic attributes, notwithstanding the large number of tunnels involved, which afford a good introduction to the large area served from the various stations.

We are not at present concerned with the lines of the North Staffordshire and London and North Western Companies, though each of them would justify individual attention. In the case of the Midland Railway, however, not only is the Derbyshire mileage considerable, and access is afforded to most of the places of principal interest, but a large proportion includes important main routes between places beyond the limits of the county. There are, in fact, in normal times, and to a large extent still, almost as many first-class express trains which traverse the Derbyshire lines without calling more than

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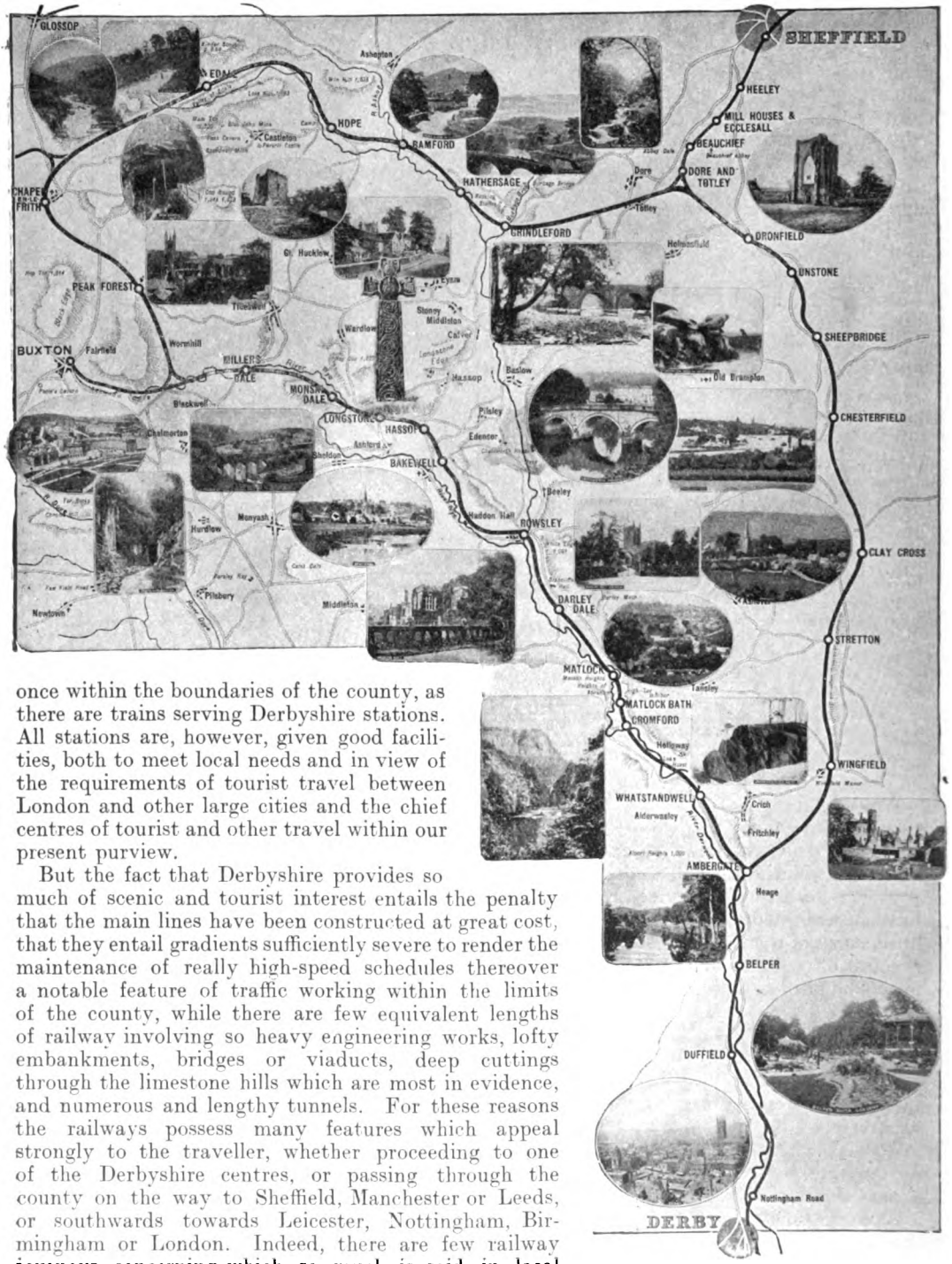

PICTORIAL MAP OF MIDLAND LINES BETWEEN DERBY, BUXTON, CHAPEL-EN-LE-FRITH AND SHEFFIELD.

once within the boundaries of the county, as there are trains serving Derbyshire stations. All stations are, however, given good facilities, both to meet local needs and in view of the requirements of tourist travel between London and other large cities and the chief centres of tourist and other travel within our present purview.

But the fact that Derbyshire provides so much of scenic and tourist interest entails the penalty that the main lines have been constructed at great cost, that they entail gradients sufficiently severe to render the maintenance of really high-speed schedules thereover a notable feature of traffic working within the limits of the county, while there are few equivalent lengths of railway involving so heavy engineering works, lofty embankments, bridges or viaducts, deep cuttings through the limestone hills which are most in evidence, and numerous and lengthy tunnels. For these reasons the railways possess many features which appeal strongly to the traveller, whether proceeding to one of the Derbyshire centres, or passing through the county on the way to Sheffield, Manchester or Leeds, or southwards towards Leicester, Nottingham, Birmingham or London. Indeed, there are few railway journeys concerning which so much is said in local guide books in reference to the lines themselves as applies in the case of the Derbyshire lines.

From the south the Midland Railway enters Derbyshire near Trent Junction, and here converge

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the Leicester and Nottingham lines by means of a complex and somewhat bewildering system of connecting loops and avoiding lines. At Derby the West of England main line comes in from Burton-on-Trent, and as North Staffordshire and London and North Western trains also work into the Midland station at Derby, while the Great Northern Railway also enters the town, though it has its own station, there is good access to the area under consideration from all directions. Towards Chesterfield and Sheffield, however, Midland trains travel direct from the south towards Leeds, take a route from Trent Junction which avoids Derby itself, this line being almost on the borders of Nottinghamshire until it strikes across a corner of Derbyshire to Chesterfield, leaving Derbyshire a few miles before Sheffield is reached, and after the northern cross-country route from Chinley to Sheffield has been joined at Dore and Totley.

North of Derby the older line follows the river Derwent to Ambergate, one of the very few triangular junctions possessing platforms on all three sides, and here Leeds and Bradford trains diverge to join the direct line from Trent Junction at Clay Cross, while the Manchester route continues to the Matlocks and so across the centre of the county to Millers Dale (Junction for Buxton) and onwards to Chinley, where the Sheffield-Chinley line comes in, thence across a corner of Staffordshire and so into Lancashire.

The Trent-Chesterfield section, though it feeds a number of branches, some of them devoted mainly to colliery activities, is not itself a centre of scenic interest, and it is mainly the triangle formed by the Ambergate-Chinley (with the Buxton branch), Ambergate-Dore and Totley, and Chinley-Dore and Totley lines, where "Peak" scenery is most in evidence, as regards the Midland lines. Each is used by first-class express trains. From London, the Manchester and Liverpool trains, whether using Derby itself or traversing the avoiding lines there, follow the Ambergate-Chinley route; but Leeds traffic is largely operated *viâ* the Trent-Chesterfield line. From the West of England main line, however, both Manchester and Liverpool and Leeds and Bradford trains follow the same route as far as Ambergate, the latter there diverging to Clay Cross and Chesterfield. The Chinley-Dore and Totley route is used mainly by Manchester-Sheffield and other cross-country services. All these routes involve notable locomotive work. Thus on the Manchester line there is a 26-mile rise from Ambergate to Peak Forest summit, with the subsequent descent; the Trent-Sheffield line includes the steep banks on either side of Dronfield tunnel; and more than half of the Chinley-Sheffield route is on gradients averaging about 1 in 100. Yet, on the whole, these steep sections are traversed very smartly, speeds being rarely much over 70 miles per hour, if as much, largely owing to the numerous curves, which necessitate careful running. An exception to this, however, is the Dronfield bank, down which speeds of 80 miles per hour, or even higher, are not uncommon.

Dealing first with the Derby-Manchester route, proceeding towards Matlock, the scenery gradually becomes more beautiful as the Peak district is entered. From Matlock to Rowsley rail, road and river keep company through Darley Dale. Rowsley is the station for Chatsworth and for Haddon Hall. Between Belper and Ambergate the line crosses the Derwent four times. Beyond Whatstandwell the line passes under a canal, over the Derwent, and through a short tunnel. In the mile between Cromford and Matlock Bath the line is mostly underground, but on emerging gives a splendid view of Matlock Bath, prettily situated in a hollow. Then the line runs above the Derwent for a short distance and tunnels under the High Tor. After another short open run, river and road are crossed to Matlock station, which serves Matlock Bridge, Matlock Bank and Matlock Town. Near Cromford connection is made with the High Peak mineral Railway, which, proceeding *viâ* Wirksworth and Parsley Hay, joins the Buxton and Ashbourne section of the London and North Western Railway. On leaving Rowsley station the Wye valley is entered. The river is crossed immediately north of the station by a picturesque bridge; about one mile further on Haddon tunnel is entered. The construction of this tunnel could have been avoided, but in that case the line would have passed alongside Haddon Hall, which would certainly have ruined the charm of that romantic building, and this, fortunately, was not permitted.

On emerging from Haddon tunnel the road continues along a high embankment above the river Wye to Bakewell. Thence to Hassop and Longstone no particular difficulties were met with in construction, but on leaving the latter station Headstone tunnel is passed through; and on emerging from this the river Wye is at once crossed by means of a viaduct of five arches. The track

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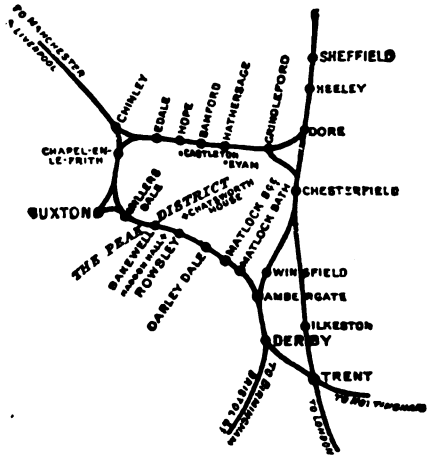

MAP OF DERBYSHIRE LINES, MIDLAND RAILWAY.

then proceeds on the side of a hill all along Monsal Dale, and through the small station bearing that name to the entrance to Cressbrook tunnel. Between this and Litton tunnel the distance is only a few yards, but the time taken to cover this with the slow trains is just sufficient to catch a glimpse of Cressbrook Dale at a great depth below the railway on the Down side.

Litton tunnel passed through, the line then continues to Millers Dale station (junction for Buxton) along a ledge on the cliff, at a great height above the river Wye. On leaving Millers Dale the railway soon enters the first and the longer of the two Chee Tor tunnels, and then crosses Chee Dale and immediately enters the second tunnel. Not far beyond this it winds along another limestone ledge through Great Rocks Dale, probably the wildest valley through which the Midland Railway passes in Derbyshire, and then continues up to Peak Forest summit through a series of cuttings.

Almost at the summit is the entrance to the long Dove Holes tunnel, which was about the greatest obstruction met with when constructing the line, and took three years to complete. Its total length is no less than 2,984 yards. From Dove Holes tunnel down to Chinley the greater part of the road lies on an embankment. The total distance from Longstone to Chapel-en-le-Frith is 12¼ miles, and between these two places there are no fewer than ten tunnels, the total lengths of which amount to over three miles. The following list, with their lengths and location with reference to stations, may be of interest :—

(Longstone station.)	
Headstone tunnel	533 yards.
(Monsal Dale station.)	
Cressbrook tunnel	471 ,,
Litton tunnel	515 ,,
(Millers Dale station.)	
Chee Tor tunnel	401 ,,
Chee Tor tunnel	94 ,,
Rusher Cutting tunnel ..	121 ,,
Peak Forest Junc. tunnel ..	29 ,,
Great Rocks tunnel ..	161 ,,
(Peak Forest station.)	
Dove Holes tunnel	2984 ,,
L. & N.W. Railway tunnel	104 ,,
(Chapel-en-le-Frith station.)	

The short stretch of line to Buxton from the junction with the main Manchester line near Millers Dale follows closely the main highway to Buxton *viâ* Ashwood Dale. In fact, it crosses over that road no fewer than four times in that short distance. The most interesting piece of that stretch of line is the embankment through Ashwood Dale.

The line from Rowsley to Buxton was commenced in the year 1860, the section as far as Rowsley having been constructed before that date, and through communication with Manchester was available for goods traffic six years later, though the route was not used for fast passenger traffic till 1867. In Vol. XVI. of the RAILWAY MAGAZINE, Mr. R. E. Charlewood, in an article on "The London-Manchester Train Service," went fully into the early history of this important section; so that further mention of this aspect is now unnecessary.

The Chinley-Sheffield route also passes through an exceedingly picturesque stretch of country. On emerging from Cowburn tunnel the Peak (Kinder Scout, 2,088 ft.) stands up on the north of the railway and little more than two miles distant, while all down the Vale of Edale magnificent hill scenery abounds; and from between Hathersage and Grindleford, where the river Derwent runs close to the line, but at a considerable depth below it, one of the finest river scenes from any railway line in England is obtained.

The tunnels on this section are only two in number, but they both appear in the list of the longest railway tunnels, Totley tunnel coming second in the list and Cowburn tunnel thirteenth, their lengths being 3 miles 950 yards and 2 miles 182 yards respectively. The construction of these tunnels was a very expensive item owing to the hard nature of

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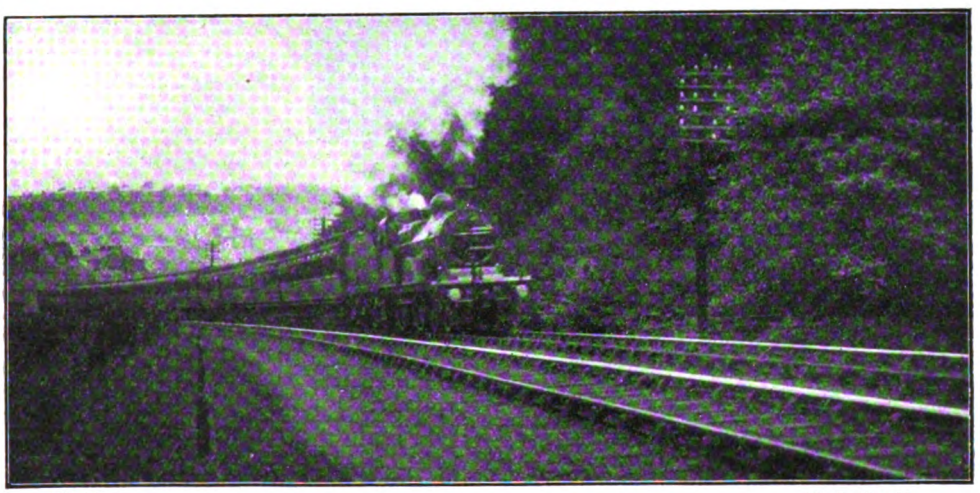
the strata traversed and to their great depth below the surface, the latter cause naturally necessitating extra work in the construction of the shafts. Although no other exceptional engineering difficulties had to be faced, deep cuttings and high embankments were frequently necessary; in fact, there is one long cutting extending the whole way from Dore station to the entrance to Totley tunnel. On emerging from the west end of the tunnel, Grindleford station is at once passed through, and thence to Hathersage the road runs on the highest embankment found on this section.

In 1892 Totley tunnel was completed, and the 20 miles of line from Dore to Chinley were opened on May 1st, 1893. Here again, steep gradients are plentiful. From the junction with the main London-Manchester line east of Chinley, the rise is at 1 in 100 to Cowburn tunnel, then up 1 in 150 for 1¾ miles, followed by half a mile virtually level; but a mile before Edale a 7-mile fall commences—nearly all at 1 in 100. From Bamford the line ascends most of the way to Grindleford, including about half a mile up 1 in 120 shortly after Bamford station, while 8 miles from Sheffield the fall begins again; the final 5¾ miles to that city being down 1 in 100. Thus it will be seen that trains from Chinley to Sheffield have a very easy time of it, as once in Cowburn tunnel it is all plain sailing; though down the long Edale bank really high speeds are seldom attained, but on one occasion, however, I did record a speed of 75 miles an hour near Hope, but in my experience that rate is somewhat exceptional.

The steepest portion of the Trent-Sheffield section is that between Sheffield and Chesterfield, as on leaving the former town the line rises up 1 in 100 the whole way to the 152½ mile-post summit, which is near the south entrance to Dronfield tunnel, thence it falls at 1 in 102 to Dronfield station, and after a momentary rise, falls for a further three miles down 1 in 100, then on to Sheepbridge, the foot of the incline, at a rather easier grade.

Yet another portion of the Midland Railway must be mentioned, this being the route from Derby to Chesterfield, *viâ* Ambergate. The distance between these two towns is 24 miles, the first ten of which form a portion of the main London-Manchester line, while near Clay Cross the Leicester-Sheffield line is joined. Thus the only portion that has not already been mentioned is only a ten-mile stretch containing no gradients of any severity. There are only two stations lying between Ambergate and Clay Cross, these being Wingfield and Stretton.



Photo] [*R. B. Gamble.*

MANCHESTER-LONDON EXPRESS APPROACHING HIGH TOR TUNNEL, MATLOCK.

It will now be of interest to examine some records of locomotive work and the train facilities offered over these sections.

There are two trains during week-days which run non-stop from Leicester to Manchester. These are allowed 112 min. for the 91½ miles, the average speed thus being 49 miles per hour. In the opposite direction we find only one train running non-stop, the booked time being precisely the same as that of the fastest down train.

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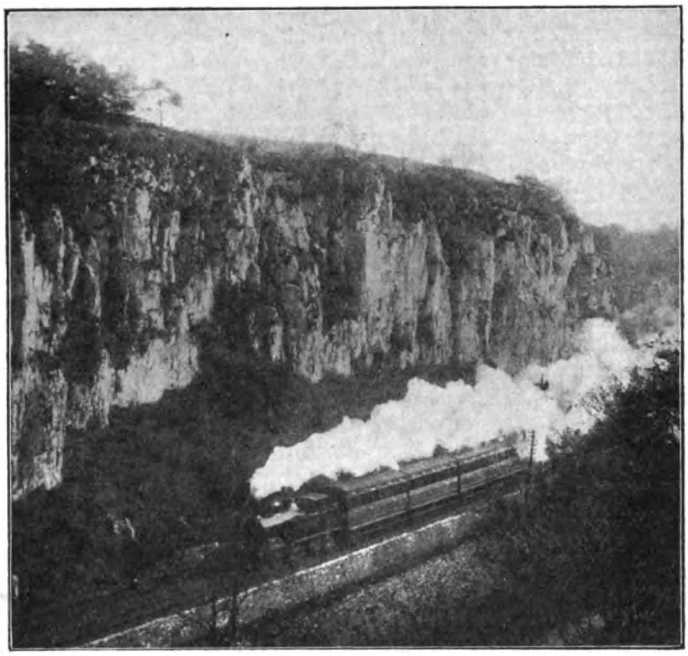

Photo] [*E. S. Hallett*

BUXTON TRAIN IN ASHWOOD DALE.

All important stations on this section have a good service of fast trains; Derby and Chinley naturally coming off best in that respect, while the smaller stations are well served by local and connecting trains. Some of the intermediate bookings appear to be somewhat slow on paper, but in actual practice, when the long and steep banks encountered are considered, it means real good locomotive work if time is to be kept.

The following is a list of the fastest intermediate bookings, including associated stages involved by trains traversing the Derbyshire lines :—

	Miles.	Min.	m.p.h.
Leicester to Derby	29¼	34	52.0
Derby to Leicester	29¼	34	52.0
Derby to Chinley	41¾	58	43.2
Chinley to Derby	41¾	52	48.1
Chinley to Manchester ..	19¾	24	49.4
Manchester to Chinley ..	19¾	29	40.8
Derby to Matlock	17¼	23	44.1
Derby to Millers Dale ..	31¼	45	41.7
Matlock to Bakewell.. ..	7¼	12	37.5
Millers Dale to Chinley ..	10¼	17	37.0
Chinley to Ambergate ..	31¼	41	46.0
Ambergate to Derby ..	10¼	15	41.0

On looking at this table it will be noted that the lowest average speed is 37 miles per hour. Millers Dale to Chinley in 17 min. is, however, probably the hardest schedule of all, and although Mr. R. M. Deeley's three-cylinder compound engines could probably keep time with a load of 250 tons, the other Midland engines have their work cut out to keep this booking with any train weighing more than about 200 tons. One train which is given this allowance is the 4.28 p.m. from Millers Dale (12.15 p.m. *ex*-St. Pancras), which is usually worked by one of the Nottingham "compounds." On one occasion the writer travelled by this train: the engine was No. 1026 (driver G. Reesby) and the load 205 tons. Peak Forest (4¾ miles) was passed in the smart time of 9 min. 45 sec., attaining 34 miles per hour up the 1 in 90; Chapel-en-le-Frith (8¼ miles) in 14 min. 13 sec.; and without exceeding 60 miles per hour down the final descent Chinley was reached in 16 min. 33 sec. Details of the work of the small 2–4–0's are seldom found in articles on locomotive performances; this no doubt is due chiefly to the fact that in these days they are not often seen working the fastest trains. In the Peak district they are frequently used on semi-fast trains, however, and that they are capable of first-rate work with light loads is proved by the following short run.

The engine was No. 141 and the load 120 tons. Starting from Bakewell, the 6½ miles up to Millers Dale were run in the smart time of 11 min. 17 sec. start to stop. The first two miles took 2 min. 48 sec., and 97 sec., and a speed of 36·6 miles an hour was reached up the 1 in 100, Longstone (2½ miles) being cleared in 5 min. 6 sec. On the short break before Monsal Dale we picked up to 47 miles per hour, the time to that station being only 7 min. 5 sec., the minimum speed to Millers Dale being 36 miles an hour.

There is no need to deal specially with the longer non-stop runs, but one run from Leicester to Chinley may be referred to as an example of the work performed on that section. The train leaving Leicester at 4.20 p.m. is allowed only 35 min. for the 29¼ miles to Derby, and 58 min. (55 min. in the

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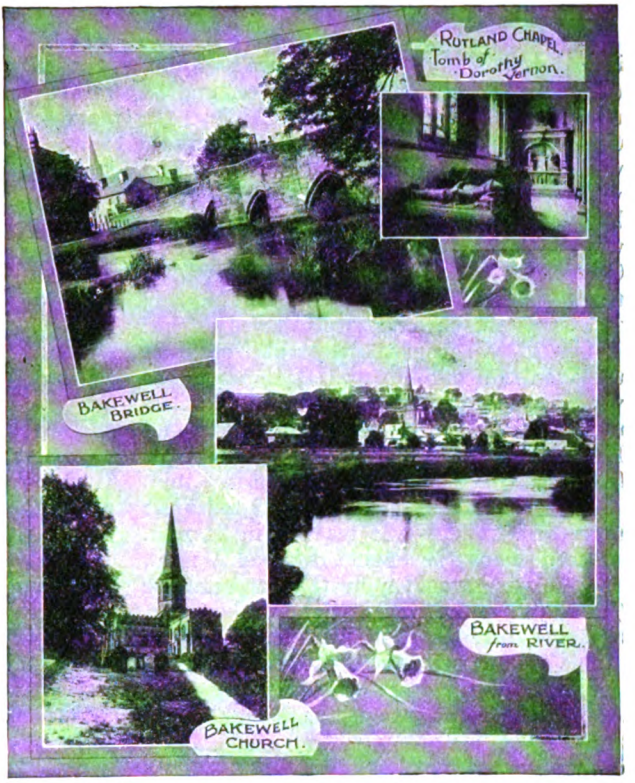
summer) for the 41¾ miles thence to Chinley. The engine was 1011, and the driver L. Robinson. A punctual start was made from Leicester, and we got away more smartly than usual, probably because the driver was aware of the necessity of a reduction of speed for permanent way operations near Ratcliffe Junction. With a load of 215 tons we passed Humberstone Road in 2 min. 17 sec., Syston in 6 min. 39 sec., and after attaining 75 miles an hour we ran through Loughborough—12½ miles—in 13 min. 30 sec.; our speed fell to 60 miles per hour at the water troughs, but rose again to 70 miles per hour after Kegworth, and Ratcliffe Junction, 19½ miles from the start, was passed in the smart time of 19 min. 47 sec. After the check, we took matters more quietly, but attained 60 miles per hour near Spondon, and after a signal check Derby was reached in 33 min. 27 sec. actual, or only 31½ min. net.



VIEWS OF BAKEWELL AND DISTRICT.

On the next stage, with the reduced load of 200 tons, the work done was rather variable. After a signal check at Matlock, which cost 2 min., we certainly did well to pick up to 55 miles per hour before Rowsley, and then ascended the bank to Haddon Box without falling below 43·3 miles an hour. After this, however, the work degenerated, and we finally fell to 29 miles an hour at Peak Forest; nevertheless, Chinley was reached 1 min. early, or in about 55 min. net. The passing times of this run were: Ambergate (10¼ miles) 12 min. 59 sec., Matlock Bath (16 miles) 20 min. 7 sec., Rowsley (21½ miles) 27 min. 51 sec., Bakewell (24¾ miles) 32 min. 7 sec., Millers Dale (31¼ miles) 41 min. 51 sec., Peak Forest (36 miles) 49 min. 48 sec., and Chapel-en-le-Frith (39½ miles) 54 min. 25 sec.

By comparing these three runs, it will be seen very clearly that the work on the semi-fast trains is in many cases quite as smart as that performed on the long-distance runs.

The following is a summary of the winter train service between Sheffield and Chinley, including those trains which stop at not more than two intermediate stations:—

Down:	one in 41 min.	(1 stop).
	„ 41 „	
	„ 42 „	(1 stop).
	„ 45 „	(1 stop).
	„ 49 „	(2 stops).
Up:	one in 35 min.	
	two in 39 „	(1 stop).
	one in 40 „	(1 stop).
	„ 42 „	(2 stops).
	„ 44 „	(2 stops).

During the summer months a train leaves Sheffield at 9.40 a.m., which runs through to Blackpool (Talbot Road), while the 11.5 a.m. *ex*-Sheffield has through carriages to Llandudno attached. The return through train is due at Sheffield at 7.40 p.m., the Llandudno portion, which runs *viâ* Buxton, being tacked on at Chinley.

Probably the hardest booked train on this section during the summer months is the 11.5 a.m. *ex*-Sheffield, which takes 49 min. to Chinley with two intermediate stops; this being the train with the through coaches

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to Llandudno, it is, of course, fairly heavy as far as Chinley, where the latter portion is detached. The times allowed are :—5 min. to Heeley, 7 min. Heeley to Dore, and 34 min. for the 21 miles thence to Chinley. On the day the following run was made there was a very strong north-west wind blowing which caught us badly on the exposed stage between Grindleford and Edale. The engine was an ordinary 4–4–0, No. 332, driver Culwick, and load 220 tons. The first two stages took 4 min. 36 sec., and 7 min. 42 sec. respectively ; Totley tunnel was entered 4 min. 11 sec. from the start at Dore, and threaded in 6 min. 45 sec., Hathersage was passed in 13 min. 36 sec., Bamford (8¾ miles) in 15 min. 36 sec., at 59 miles per hour, and Hope (10½ miles) 2 min. later. The 4⅞ miles from Hope to Edale were covered in 8 min. 18 sec., at a minimum speed of 29 miles per hour, and Chinley was reached in 34 min. 29 sec. Thus the engine dropped ½ min., but the wind would more than account for this slight loss of time. It shows, however, that the train is smartly booked, though others are allowed less time to complete the journey, but these are as a rule very light, and as the result the faster schedules are easier to adhere to. The train for Manchester which is due out of Sheffield at 5.22 p.m., was only allowed 18 min. to the stop at Grindleford, which was by no means an easy schedule, as is shown by the following run :

Locomotive 435. Driver, W. Elston. Load 175 tons.

Miles.	Station.	M.	S.
0 ..	Sheffield	0	0
1½ ..	Heeley	3	38
2¾ ..	Millhouses	5	57
3½ ..	Beauchief	7	20
	attain 36·6 m.p.h.		
4¼ ..	Dore	8	28
9¾ ..	Grindleford	17	2

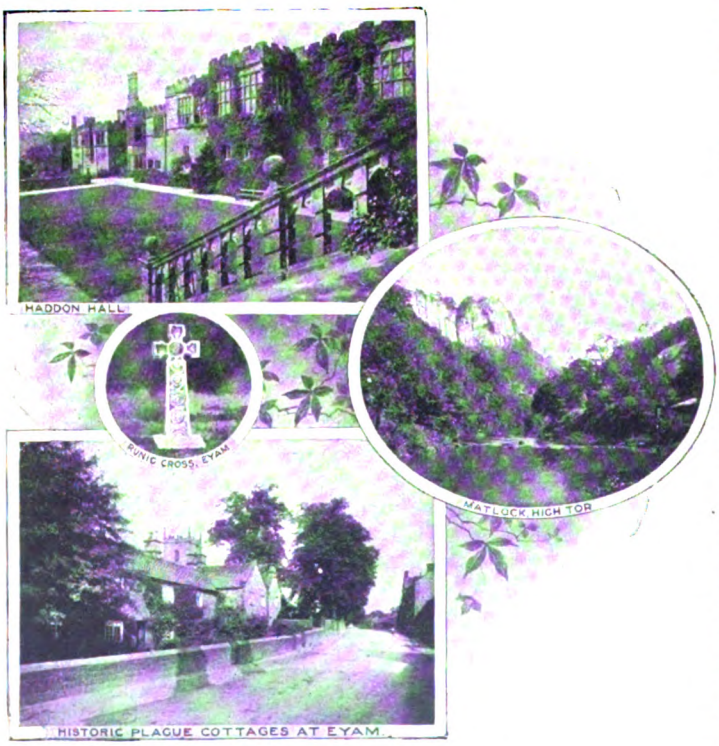
The distance between Sheffield and Leicester is 59½ miles, and the fastest down train covers this distance in 77 min., this being the 3.18 p.m. *ex*-Leicester (1.30 *ex*-St. Pancras) which reaches Sheffield at 4.35 p.m., thus averaging 52 miles per hour for the 158¼ miles from London with an intermediate stop. Two up trains complete the journey in under 80 min., the 9.0 a.m. and 11.8 a.m. out of Sheffield, arriving at Leicester 10.15 and 12.22 respectively.

The following is a list of the fastest trains between Sheffield and Nottingham (distance 40¾ miles) :—

Down trains:	one in 55 min.
	,, 57 ,,
	,, 58 ,,
	,, *65 ,,
Up trains:	one in *62 min.
	,, *64 ,,
	,, *67 ,,
	,, *69 ,,

* With one intermediate stop.

Better locomotive work, as a rule, appears to be done on the Sheffield side of the Dronfield tunnel, and for up trains of any weight it is certainly a very hard pull. The heaviest train I have had up this bank is the 11.8 a.m. *ex*-Sheffield (10.15 a.m. Leeds-London express) ; the load was no less than 258 tons empty, or about 280 tons including passengers, etc. Compound locomotive No. 1005, driven by Davenport, covered the first mile in 3 min. 28 sec., the second



TYPICAL DERBYSHIRE VIEWS.

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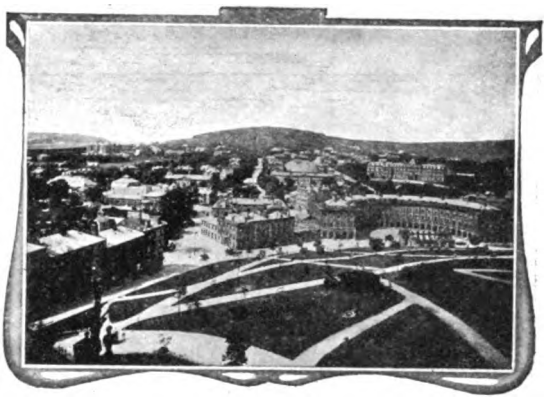
in 2 min. 9 sec., and the next two in 1 min. 59 sec. and 1 min. 56 sec. respectively. Dore was passed in 10 min. exactly, and Dronfield tunnel entered at 31·7 miles an hour. The 7 miles to Dronfield occupied 14 min. 39 sec., but the subsequent 5¼ miles to Chesterfield only 4 min. 25 sec.—78 miles an hour—while the maximum attained was the high one of 81 miles per hour.

This train is booked to pass through Chesterfield in 16 min., but, of course, with a load of 280 tons this is impossible, and we certainly did remarkably well to reach that place in 19 min. 4 sec. When steam was shut off to prepare for the Clay Cross service slack, speed had not gone below 58 miles an hour, and we passed the 143rd mile-post in 22 min. 3 sec. from Sheffield, and Clay Cross (16¼ miles) in 22 min. 53 sec. at reduced speed.

From here to Doe Hill the line rises on a gradient of 1 in 165, and up this we maintained a steady 43 miles per hour. We passed Doe Hill—19¾ miles—in 27 min. 46 sec., and Alfreton—22½ miles—in 30 min. 23 sec., and had then got up to 63 miles an hour, but encountered a signal check at Pye Bridge which cost us about 1¾ min. A smart recovery followed, and 70 miles per hour was maintained for a short distance between Trowell and Stapleford; after this we had a bad time, being checked by signal to 10 miles per hour at Toton Junction, almost stopped dead at the 121 mile-post, and again at Long Eaton, and we finally crawled through Trent in 51 min. 25 sec.—about 45½ min. net.

After all these delays, however, we reached Leicester in 75 min. 5 sec., or only 1 min. late, while the net time for the run was not more than about 69 mins., a clear gain of 5 min. on schedule. This run is a typical example of every-day running over this section, and further runs, therefore, need not be mentioned.

Ample facilities are offered to those travelling on all these sections, and in normal times a good selection of cheap day and half-day tickets are issued between the important towns and to places of interest in the country; while for visitors holding tourist tickets from London to stations in the Peak district special privileges are offered in the form of contract tickets at the remarkably



GENERAL VIEW OF BUXTON.

cheap rate of 10s. for a fortnight, available at all intermediate stations between Ambergate, Buxton, Chinley and Grindleford, thus enabling passengers to make a complete tour of the neighbourhood for a most moderate outlay. Even from the Midland Railway itself a splendid idea of the beauties of Derbyshire can be obtained, views of many of the most beautiful dales being seen, *e.g.*, Monsal Dale, Millers Dale, Chee Dale, and Ashwood Dale, all of which come between Bakewell and Buxton.

Travelling facilities offered to the inhabitants of Sheffield and that neighbourhood are excellent. A plentiful supply of cheap tickets are issued to Buxton and many of the interesting towns in the Peak district, while at the small rate of 1s. per week tickets are issued available at all intermediate stations between Sheffield and Dore for as many journeys daily as required. Although passengers are able to travel at such cheap rates, everything appears to be done to ensure the comfort of those who take advantage of such facilities, the rolling stock, even on the excursion trains, being as comfortable as one could wish, and the Midland Company are certainly to be congratulated on the splendid way in which they encourage visitors and others to travel on their system in Derbyshire.

In conclusion, it may be stated that the train services mentioned are those in force before the commencement of the great war. Naturally for the present trains and facilities must necessarily be restricted, but no doubt when peace is once more restored the attractions of the Midland Railway in Derbyshire will all be once again revived.

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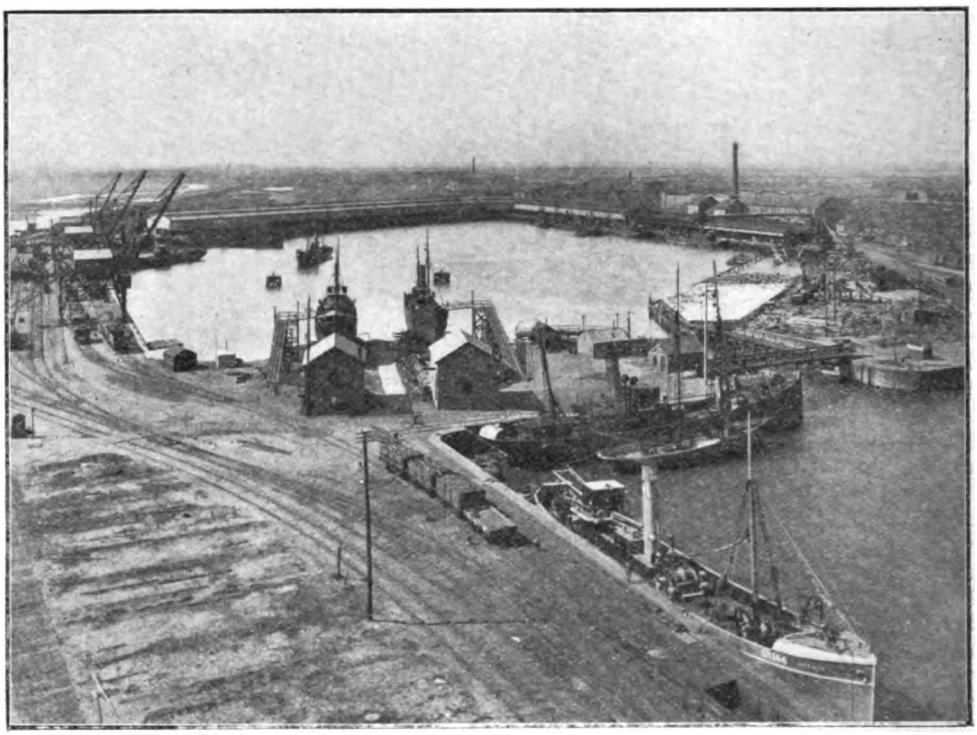

GENERAL VIEW OF NEW FISH DOCK, WYRE DOCKS, FLEETWOOD.

The Lancashire and Yorkshire Railway Company's Wyre Docks, Fleetwood.

AMONG many indications of the progressive policy of the Lancashire and Yorkshire Railway in relation to the busy industrial centres through which its system passes, particular mention must be made of the development of the Wyre Docks, and at the Port of Fleetwood on the Wyre Estuary in Morecambe Bay.

There one finds commodious and well-equipped docks, capable of dealing in an expeditious and up-to-date manner with every class of traffic that may be offered. The main dock measures 1,000 ft. by 400 ft., and is approached from the Wyre Channel through a lock 250 ft. long by 50 ft. wide at the quay level, with a total quay space of 2,700 ft., the whole of which is served by lines of railway and numerous quick-working cranes. On the north-eastern side of the main basin is a large grain elevator belonging to the railway company. This building has been erected on the most approved principles, and represents an assimilation of the best English and American ideas for the efficient and economical handling of grain traffic. Between the grain elevator and the quay, and immediately adjoining the latter, is a "ship's leg," by means of which the grain is lifted from ships' holds and "spouted" on to an endless band for conveyance underground to the basement of the elevator. On arrival there it is lifted to the top storey of the building, where, fed into hoppers, it is weighed, up to five tons being dealt with at each operation. Thence the wheat passes along an endless band to one or other of the 143 storage "silos" into which the building is divided. Each of these "silos" has a capacity of over 200 tons, or a total of about 30,000 tons of grain. The outlets to the "silos" are on the bottom floor, and here the grain is released as and when required, placed in sacks, weighed, put

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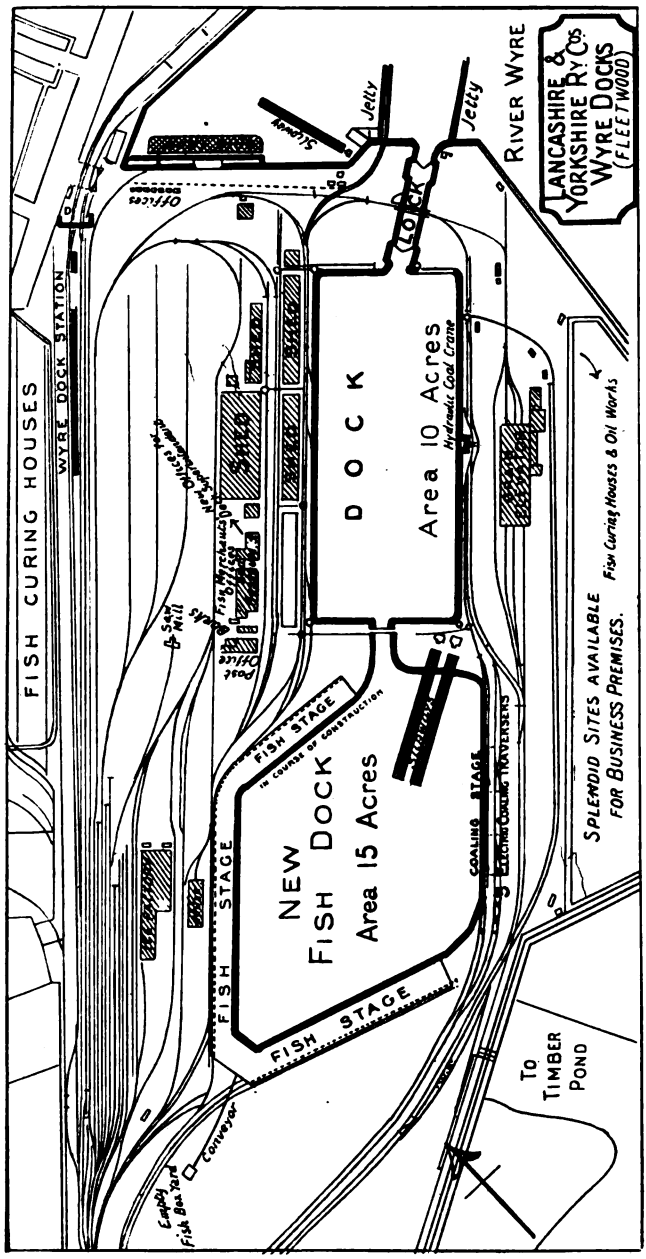

on to wagons standing on lines of railway running through the building, and so forwarded with the utmost despatch and economy to consignees. The whole of the "silos" are fitted with patent "mixers" which provide for a uniform sample, while the arrangement of the storage bins in connection with the endless band conveyor enables different qualities of grain to be mixed in accordance with the instructions of the importer, at the same time securing the automatic cleansing of the cereal. The elevator also contains what are known as "shakers" and "blowers" for the restoration of heated and damaged cargoes, so that the grain as it leaves the building is in the best possible condition.

One of the most striking features of the Dock Estate is the large number of timber stacks seen at almost every turn, and the rapid manner in which the cranes operating along the edge of the quays remove these cargoes from vessels berthed alongside is most noticeable. Very often this class of traffic is required for immediate despatch, and it is then simply lifted from ship to wagons. Should storage be desired, there are, in the immediate vicinity of the docks, large areas of dry, gravelly soil, intersected by sidings, and this land is peculiarly adapted for the stacking of timber. For the accommodation of log timber traffic a pond is provided, and into this the logs are discharged, to be rafted awaiting purchase.

Wyre Dock shares to a large extent in the import of foreign ores, and if the ore be required for immediate delivery, it is lifted from the holds of the vessels by as many cranes as there are hatchways and loaded direct upon wagons standing alongside. For coal, both for shipment and for bunkers, a hydraulic crane has been erected, capable of lifting wagons bodily and lowering them to the deck level before discharge. This system, while securing the minimum of breakage, allows 250 tons of coal per hour to be put on board.

Besides the foregoing facilities for dealing with these different classes of traffic, ample

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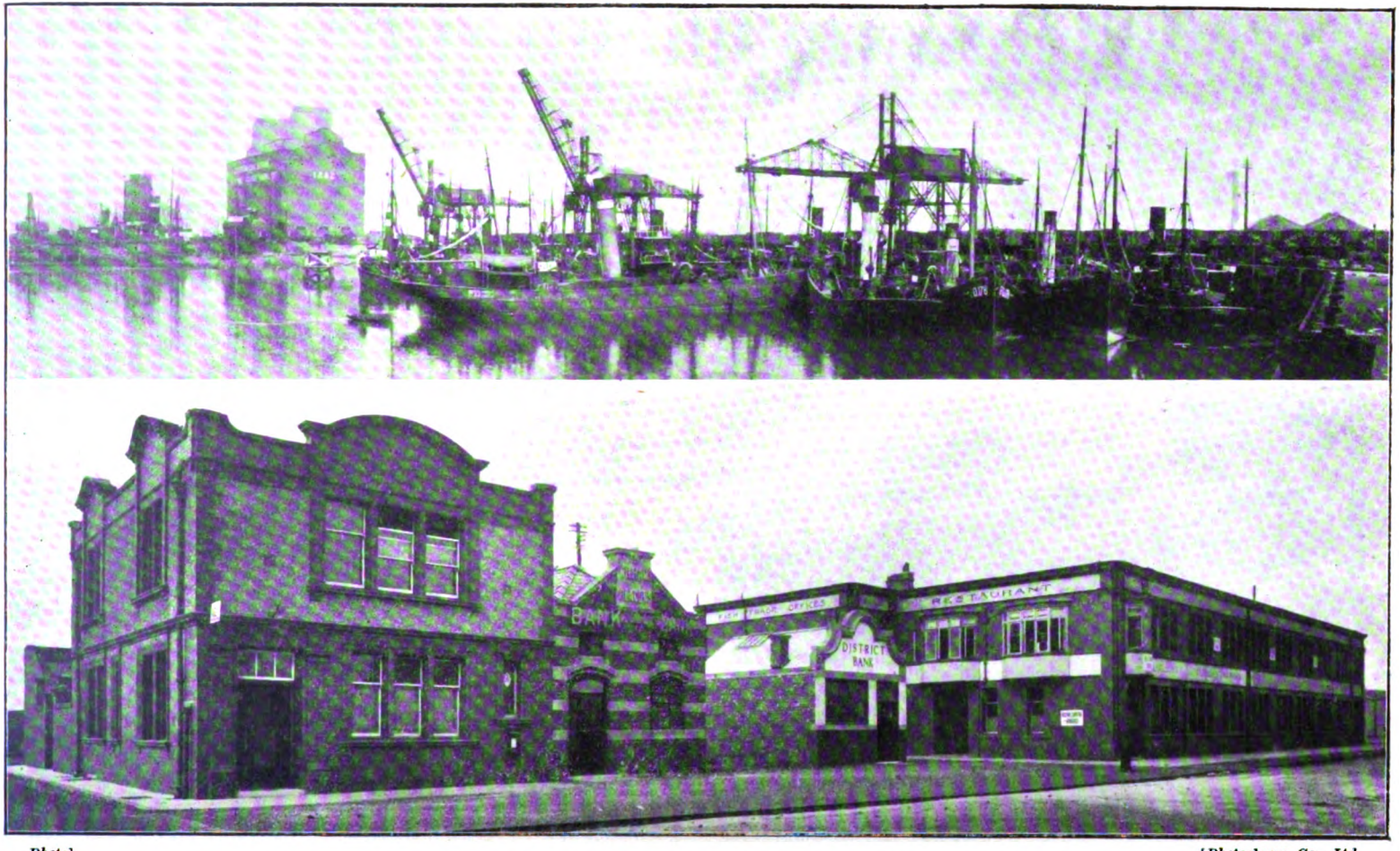

Photo] *[Photochrom Co., Ltd.*

(1). Grain Elevator and Coaling Cranes for Trawlers.
(2). Post Office, Banks, Fish Trade Offices and Restaurant.

VIEWS AT WYRE DOCKS, FLEETWOOD.

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dry shed accommodation is available for such general import and export business as may be offered, all being directly connected by lines of railway with the various quays. These sheds are especially adapted for the storage of wood pulp, esparto grass, cement, china clay and other commodities, brought into and taken out of the Docks by ocean-going and coasting steamers.

The dock and harbour dues and stevedoring and other charges are low, and, in the present state of the shipping trade, owners and charterers should consider Wyre Docks before fixing their arrangements, as, taking all factors into account, the port is one of the most economical in the country.

The most remarkably successful enterprise at the Wyre Docks has been the steam trawling industry. The first steam fishing vessel entered the port in 1891, and since 1897 there has been a continuously large increase in the business, the weight of wet fish landed in 1914 being well over 60,000 tons.

In 1908 there were 60 trawlers fishing out of the port, and in 1914, immediately prior to the war, there were 130 vessels regularly landing catches, whilst about 30 new boats were being built. This extraordinary development has followed the provision by the railway company of a dock 15 acres in extent, used exclusively for trawlers and affording excellent facilities for all branches of the fish trade. The Fish Market is on the quay and provides covered slade accommodation with a frontage of 2,000 ft. and 70 ft. wide, constructed of concrete. The slades rise gently from the dock side to the back, where the fish, after sale, is loaded direct into the railway vans. There is a splendid service of goods and passenger trains to the large towns, through trains running to London and the important provincial markets, whilst the Lancashire and Yorkshire Railway Company's own system serves the thickly populated districts of the two counties from which its title is derived. There are overhead lofts over the slades for the storage and repairing of boxes, and the latter are brought from the "empties" yard by means of an electric

Photo] [*Photochrom Co., Ltd.*

HERRINGS LAID OUT FOR SALE, NEW FISH DOCK, WYRE DOCKS, FLEETWOOD.

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conveyor. The boxes are lowered from the lofts to the slades through trap-doors.

At the port there is the most complete ice factory in the country, owned by the Fylde Ice and Cold Storage Company, with an output of 200 tons per day. The ice is cheap, and shoots at various points on the slade enable boats to be "iced" at the rate of one ton per minute.

There is a good supply of cheap steam coal, which is put on board vessels away from the fish-discharging berths by means of three quick-working electric-travelling cranes each capable of dealing simultaneously with two boats lying abreast at the rate of 50 tons per hour. There are no dues on coal for bunkers. Water is delivered on board all vessels direct by hydrants fixed along the quays, obviating the necessity for "tank" boats, which have to be employed at so many ports. Slipways enabling trawlers to be drawn out of the water for examination and overhauling have been constructed recently, and there are several engineering firms in the town who specialise in repair work.

Large curing and smoke houses have been erected, and also factories for dealing with fish offal and converting it into marketable commodities (oil, meal, manure, etc.), and sites at low rentals are available for works and business premises both on the Dock Estate and in the town. There are also large salt works in the neighbourhood where all kinds of salt are obtainable.

The present dues per trawler are 26s., which cover all expenses in the way of light and dock dues, together with the use of run-planks and staging for discharging purposes. The figure is also inclusive of the use of the quay for dealing with the catch, and there are no dues on the fish landed.

Adjoining the Fish Dock, an interesting feature is the new building containing offices for the fish trade and a restaurant. A post office and banks have also been established within a few yards of the fish market. In addition, there is excellent accommodation for the storage of ships' stores, net stretching, etc., supplies of which can be purchased from branches which have been established in Fleetwood by the best firms in the kingdom.

So much for the enterprise of the last few years; but the railway company are determined not to stand still. They believe there is a great future for the port and particularly for the fishing industry, and at the present time several large extension schemes are in progress. The principal of these is the provision of further slade accommodation on the north side of the Fish Dock with a frontage of over 450 ft., and, like the existing stages, will be 70 ft. wide, with railway lines behind. When this is completed it will give discharging berths for trawlers on three sides of the dock and leave the fourth side entirely for coaling purposes.

Hitherto a tug has only been employed for the movement of trawlers in the docks at very busy periods, but the fishing fleet is growing so rapidly that the railway company, anticipating developments, are building a boat specially for the purpose, which will be delivered shortly. The charges for the use of this tug will be low, and by employing it owners will be saved considerable expense, as, under ordinary conditions at the present time, they have to keep their boats in steam for long periods whilst in port.

Another work now in hand is the erection of new offices for the Dock Superintendent and his staff near to the Fish Dock. This building will be of very handsome design, and although the completion of these premises will only be a comparatively small facility so far as the trade is concerned, it affords a further illustration that the policy of the authorities is to maintain the up-to-date reputation of the port of Fleetwood.

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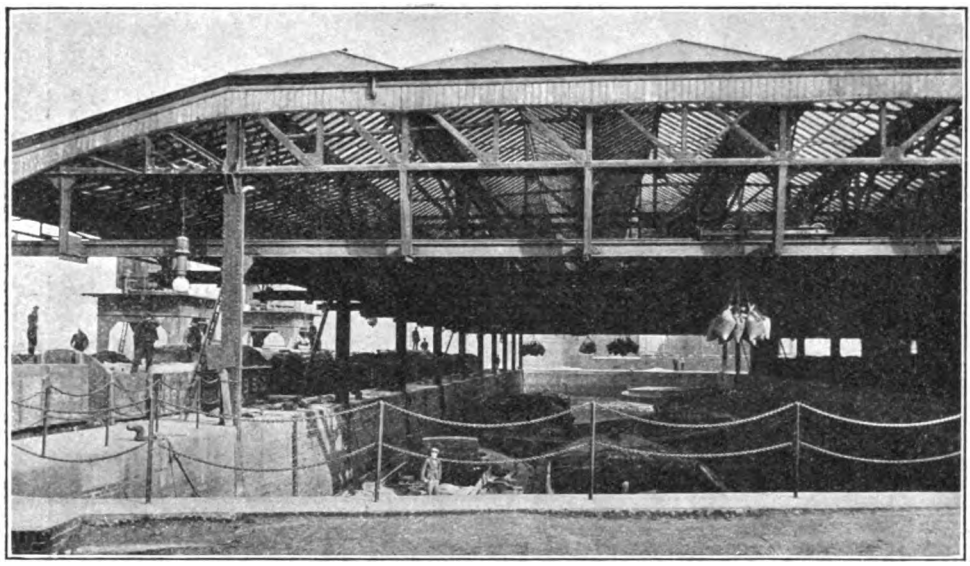

ELECTRIC TRAVELLER AT DEPTFORD WHARF, LONDON, BRIGHTON AND SOUTH COAST RAILWAY.
This installation was fully described in the April RAILWAY MAGAZINE.

Railway Electrical Progress and Practice.

By "INDICATOR."

IN these articles, although they have been running only a few months, a variety of applications of electric agencies in railway service have been dealt with, but the field is far from exhausted, and additional phases are continually being added. For this article we may take as a starting point the system of semi-automatic lift control introduced at several stations on the "tube" railways, whereby the liftman ceases to travel with the passengers as hitherto. It is true there is nothing very exceptional in this development, for not only semi-automatic but also automatic lifts are in use in office buildings, warehouses, etc.; and there is no record that if properly designed and looked after they are in any degree less safe than those where the liftman exercises control from inside.

The lift problem has always been somewhat of a difficulty on the underground lines, and is mainly acute at times of heavy traffic pressure, that is at those periods when the demands upon efficiency and expeditious working are most serious. Thus every one who travels by "tube" trains knows the experience of irritation aroused by the fact that a lift advertised "to connect with each train," as often as not arrives at the lower landing as the train is moving out. It may be that the advertisement applies, say, to "Westbound" trains, and the passenger in a hurry is going eastward; but the average "tube" traveller interprets the notice to suit himself and bothers little about whether he is proceeding north, south, east or west; his concern is to get into the right train for his destination.

There are also the delays incidental to waiting on the lower level for the dilatory passenger who is ready to make trouble if the lift ascends without him, and the "last man" whose appearance just as the liftman is closing the doors adds "precious seconds" to the time spent at the upper landing; while at busy periods it is frequently quite a scientific problem to load a lift to its full capacity and to find room for the attendant adjacent to his control gear, in order that there shall not be any passengers left behind. In fact, the time spent at stations between booking office and platform, or platform and exit, is often the most adverse factor in "tube" travel, though it is accentuated in many

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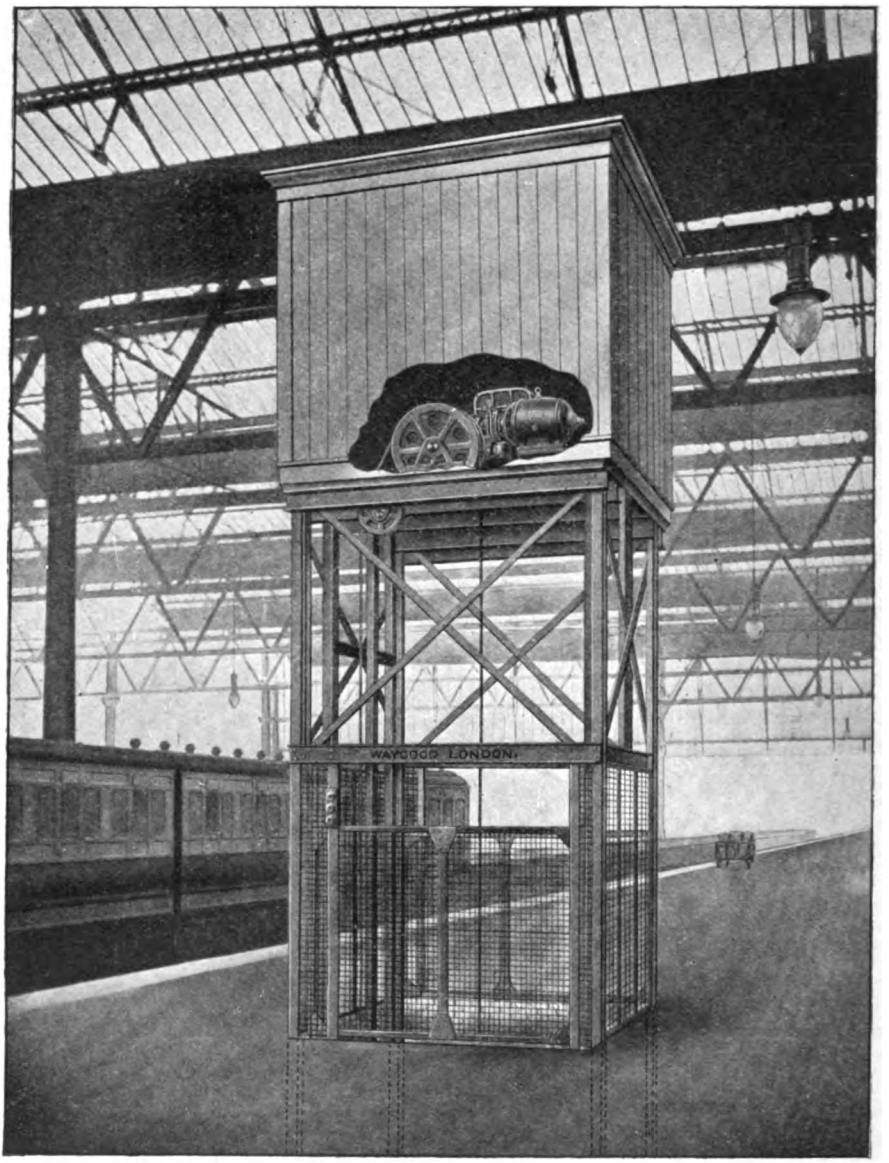

WAYGOOD-OTIS ELECTRIC LUGGAGE LIFT INSTALLED AT WATERLOO STATION, LONDON AND SOUTH WESTERN RAILWAY.

places by the lengthy and bewildering passages to be traversed at the lower level. It is, indeed, a great factor in favour of the motor omnibus for short journeys, and neutralises some of the gain in quick transit afforded by the "tube" railways.

Escalators provide the only real remedy, as no other agency enables passengers to be dealt with as they present themselves, constituting an equivalent to a continuous lift service to suit each individual traveller; but so many of the "tube" railways were equipped with lifts before the cult of the escalator came into vogue, while the substitution of escalators, as at Oxford Circus, is not only a costly proceeding, but almost inevitably entails very expensive and difficult underground engineering problems.

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The provision of compressed air gate opening devices, and the arrangement whereby passengers leave a lift at the side opposite that where they entered, has militated the lift evil somewhat; but principal interest is now afforded by the system now in operation at the Piccadilly Circus, Euston and Great Central "tube" stations. The idea is that the lift attendant shall not travel with the lift at all, so that there is no necessity for him to squeeze his way at the last moment into a crowded lift, neither is he obliged to stand right in the way of passengers in order to check or collect tickets. There are also other advantages, in that the liftman is able to keep a better watch on passengers approaching the lift, and he can therefore more accurately judge the moment for closing the gates.

From the newspaper references to this development an impression was given that there was something marvellous about it. Actually, however, it is merely the transfer of control from the controller and plungers inside the lift to a control board outside it, and whereas one lift attendant usually confines his attention mainly to his own lift, there is now an attendant at the upper landing and another at the lower level each in charge of a pair of lifts, the usual system being that as one is ready to descend the other is available for ascent. The electrical controls are, however, exactly equivalent to what has hitherto been provided, and for some time all modern lifts, as also some of the older ones which have been re-equipped, have not only been fitted with compressed air gate operating mechanism, but also arranged that while the liftman starts the lift, it stops automatically as the landing is reached.

The control board has nine plungers, the whole being rendered inoperative unless an "interlock" key is inserted and turned, thus ensuring that it cannot be interfered with or used except under proper oversight. There are two closing and two opening plungers respectively for the entrance and exit gates. That for opening the exit gates applies whether the lift is standing or is at the other landing, but is inoperative until a further contact is completed by the arrival of the lift. That is, after a lift has started the despatching attendant presses his plunger and the exit gates then open on arrival at the upper or lower landing, as the case may be.

There are also two starting plungers, "up" and "down," but as only one normally applies the other is sealed so that it can only be used for emergency purposes. Another plunger enables the lift to be stopped immediately should the necessity arise, while the eighth plunger enables this to be reset. Both of these are coloured red. Finally there is an "indicator" plunger. This applies to the illuminated sign directing attention to the lift next in use. This sign is illuminated automatically as a lift becomes available, but occasionally the particular lift concerned may not be the first to descend; hence the provision of the special "indicator" plunger for cancelling the sign.

The manipulation of a lift is as follows, dealing with one due to leave the upper landing. Ascending passengers having left, the exit doors are first closed by the plunger, and when loaded the entrance gates are similarly closed. The "down" plunger is then pressed, and the lift descends, the attendant meanwhile operating the exit opening plunger so that the exit gates will open on arrival. At the lower level the other attendant takes charge, opening the entrance gates and closing the exit doors ready for sending the lift up again in the same manner. The other plungers are only used for emergency or special purposes as already mentioned, and existing rules and methods for dealing with any unusual conditions which may arise apply as usual.

As it is not always necessary to use the lifts in this way the ordinary internal control appliances are retained, and after placing the control board out of action by removing the "interlock" key the lift can be operated by a travelling liftman.

The introduction of this system of lift control has already fully justified itself at the stations mentioned, and no doubt others will be equipped in due course.

Lifts, as a general subject, provide a wealth of material; but a few general remarks will be sufficient for present purposes. On the passenger side they are most in evidence on railways of a "tube" character where, in fact, they are almost unavoidable except with escalators as an alternative. There are now a few stations where both systems are in use; thus at Oxford Circus lifts deal with one portion of the traffic and escalators with the other, while at Liverpool Street (Central London Railway) there are two lifts serving the high level circulating area of Broad Street station—surely this is the only instance where lifts connect levels

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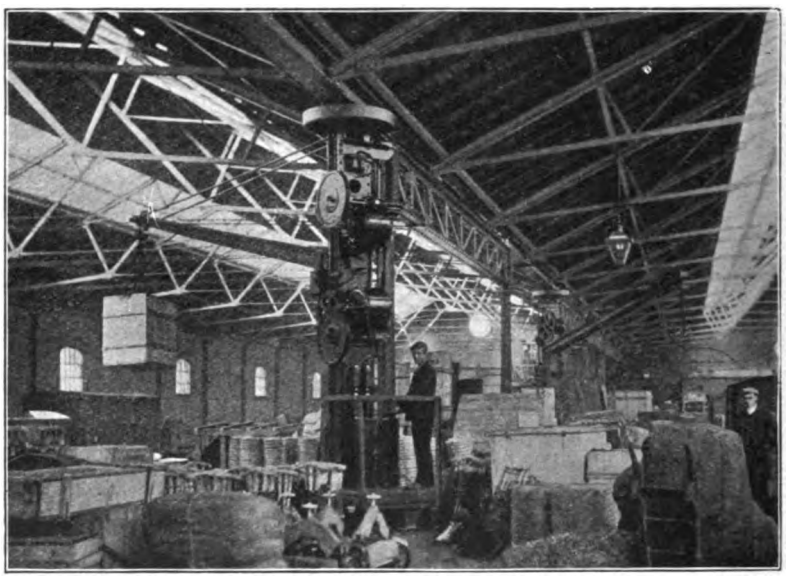
above and below road level—while the escalators run only between the underground station and the circulating areas which are themselves lower than the public roads outside. Many of these railway lifts are of considerable size, and may easily accommodate fifty or sixty passengers without undue crowding. Yet a battery of four large-capacity lifts is frequently kept busy the whole time traffic is heavy. Earlier ones were arranged so that passengers left at the same side as they entered, and gates had to be opened by the attendant. In modern practice compressed air gate-opening mechanism is usual, and in order to avoid the confusion incidental to the older policy of



ROYCE ELECTRIC JIB CRANES AT NEPTUNE STREET WAREHOUSE: HULL AND BARNSLEY RAILWAY.

"last in, first out," it is generally arranged that exit is made opposite to the entrance side. In the process of modernising some of the older lifts the entrance and exit passages at the lower level have been transposed.

Otherwise the lifts used for passenger traffic are mainly to be found in railway office buildings, and as they correspond exactly with equivalent practice in other applications, there is no need to deal specifically with them. On the goods side, however, the subject presents many features of interest. In large warehouses, lifts and hoists are extensively used, either for transfer of bales and packages between floors, or for raising or lowering wagons intact, from ground level to floors above or below. For light duties hand power is sufficient, but, as a rule, hydraulic or electric power is desirable.

Where a high-pressure system is available, as is the case in most large towns such as London, Manchester, Liverpool, etc., working at a pressure of 700 to 1,000 lb. per sq. in., hydraulic arrangements are very satisfactory in working, and may be cheapest in final cost, while the machinery is of very simple character and requires very little skilled attention, and is not liable to injury through overloading. On the other hand, where electric current is available, there is much to be said in favour of the electric lift, especially as current can now be obtained very cheaply, while for many purposes electrical operation is most convenient.

One of the great advantages of the employment of electric lifts is the great convenience of control by means of a small car switch or pushes instead of a hand rope, and the facility with which interlocking gear can be connected to the landing gates as a precaution against accidents through gates being left open, or opened when the lift is not opposite the floor.

In goods lifts, where price is a consideration, the winding gear is often fitted with a "V" grooved winding sheave instead of a

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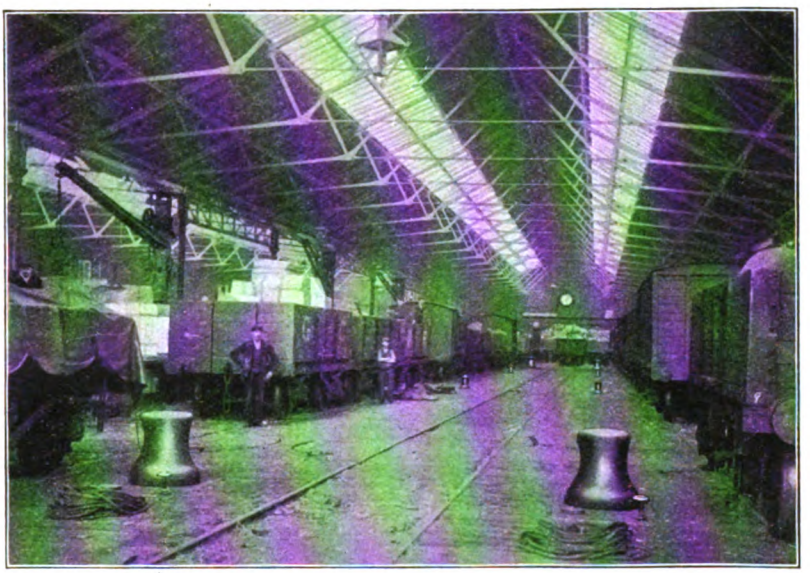
drum, the drive in this case being obtained by the friction of the rope in the grooved wheel. The ropes are connected at one end to the cage, and at the other end to the counterbalance weights. Limit switches provided in the well-hole are operated by the cage or balance-weight in case of overtravel, and shut off the current from the motor so as to bring the whole apparatus to a standstill.

The control for goods lifts may be on either of the following systems :—

(1) Hand rope control is the simplest and the cheapest in the first cost, and, where the lift is always worked from inside the cage, is convenient and reliable.



ROYCE ELECTRICALLY-DRIVEN CAPSTANS AT THE NEPTUNE STREET GOODS WAREHOUSE, HULL: HULL AND BARNSLEY RAILWAY.

(2) Electric control with car switch, or with buttons in the cage, which is rather more expensive, but is very convenient where exact adjustment of the level of the cage is desired to the level of the floor, especially for running trucks in and out of the cage, as the stopping with the electric current is more instantaneous and consequently adjustment is easier.

(3) Electric control with button operation from landings.

In the majority of cases goods lifts are required to be controlled from the floors without anyone riding in the cage. In this case the system of electric control with switch in cage, and with three buttons fitted on each landing, is suitable. One button starts the lift "up," the second starts in a downward direction, and the third "stop" when required. Electric contacts are also fitted to the gates on landings to prevent the lift being started unless all the gates are closed, and so prevent danger of the lift being started off while it is being loaded or unloaded.

As regards examples of lift practice, it may be mentioned that at Clapham Junction, L.B. & S.C.R., there are three electric lifts, each fitted with a six horse-power motor on push button control, with safety bar device. These are each capable of carrying 15 cwt. at 60 ft. per minute. At Sutton a lift fitted with a 7·5 horse-power single-phase alternating-current motor, and operating on push button control, is provided to facilitate dealing with milk traffic. This has a capacity of 20 cwt. at 60 ft. per minute.

At Hove two electric lifts by Waygood are installed for dealing with passengers' luggage, milk and general merchandise, each fitted with 5 horse-power motors having a capacity of 15 cwt. at 60 ft. per minute. Two electric lifts are installed at Worthing for passengers' luggage, fruit, etc., each fitted with 7·5 horse-power motors with push button control and a carrying capacity of 20 cwt. at 70 ft. per minute.

Messrs. Waygood-Otis, Ltd., have installed at Waterloo station, London and South

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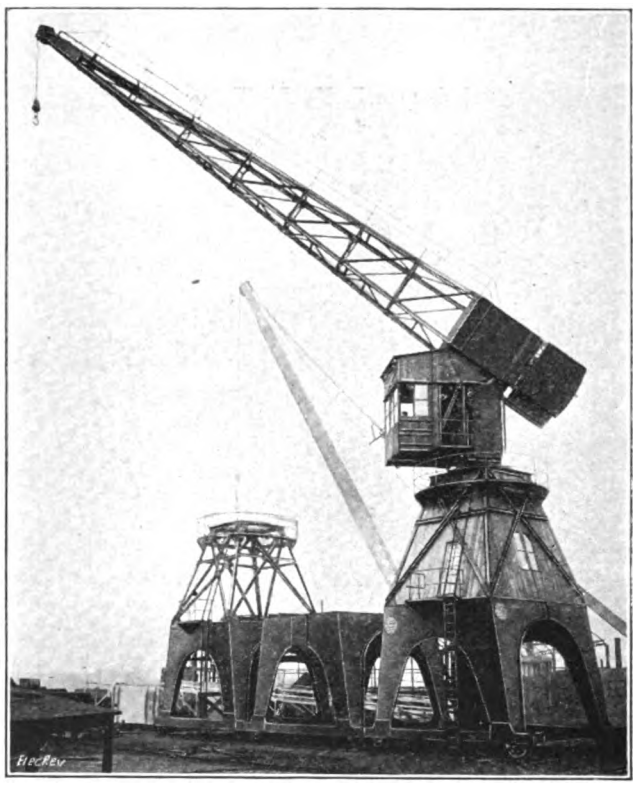
Western Railway, seven electric lifts for dealing with baggage and merchandise. Each lift carries a load of 30 cwt. at a speed of 90 ft. per minute, and has a cage 6 ft. 3 in. by 9 ft. 1 in. by 7 ft. high. These lifts are operated by push button control from the cage and from each landing. This firm has also supplied the London and North Western Railway with the following equipment:—Five lifts at Wigan, three lifts at Rock Ferry, five lifts at Harrow, four lifts at Bushey, and two lifts at Carlisle passenger stations, besides a number of lifts for the station both electric capstans and electric cranes are employed. The capstans, when first installed, were of the pedal-controlled non-reversing type, on which loose hemp ropes were used, but three of these, built by Messrs. Royce, Ltd., Trafford Park, Manchester, have since been converted to the reversible bollard type, each with a fixed extra-flexible steel wire rope, 250 ft. long and ½ in. diameter, the controller, of the standard tramway type, being fixed in a small cabin adjacent. Each capstan is provided with a 20 b.h.p. totally enclosed, series-wound,



3-TON ROYCE ELECTRIC CRANE: HULL AND BARNSLEY RAILWAY.

North Eastern and South Eastern and Chatham Railways, at various stations.

It is, however, in connection with crane power that electricity is advancing so rapidly in reference to the equipment of railway goods stations and warehouses. In the RAILWAY MAGAZINE for July, 1914, extended reference was made to the development of electrical machinery on the North Staffordshire Railway. Thus, at Hanley, in connection with the working of the warehouse, bonded stores, goods yard and passenger reversible, multipolar continuous-current motor, with self-oiling ball bearings and fitted with two sets of carbon brushes at the top of the commutator only. The design provides for a sustained direct pull of one ton at the rate of 120 ft. per minute.

The electric jib cranes, also built by Messrs. Royce, Ltd., each consist of a centre post carried in a cast iron footstep embedded in concrete at the bottom, and a cast iron bearing at the top, fixed to the roof of the building. The centre post carries the hoisting

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gear, also the motor and tramway type controller, together with the main switch and fuse. The load of 30 cwt. is lifted by a ½ in. diameter flexible steel wire rope. The hoisting motion is actuated by a 7½ b.h.p. totally enclosed, direct-current compound-wound 4-pole reversing motor, driving, through spur gearing, the cast iron rope barrel which is carried on a mild steel shaft. The slewing is done by pushing the load round by hand. A powerful automatic magnetic brake is applied at all times except when the motor is actually hoisting the load, and this brake is provided with a hand lever for lowering the load by gravity at any required speed. The empty hook is lowered by reversing the motor.

Again, in our April, 1915 number, particulars were given of electric crane and other equipment on the London, Brighton and South Coast Railway. The working plant at Deptford Wharf includes a 3-ton electric derricking crane (Stothert & Pitt) serving a radius of 35 ft., and fitted with two 40 horse-power and one 8 horse-power motors. This is generally used with 30 cwt. grabs for unloading coal and other minerals, in conjunction with the hydraulic cranes. There are also eleven 20-cwt. electric travellers, also supplied by Messrs. Stothert & Pitt, and each fitted with three motors of 16, 6 and 3 horse-power respectively. These are used for unloading grain and other produce from lighters and barges into railway wagons or for warehousing. A 15 horse-power electric capstan is also available, and this provides for a pull of one ton at 50 ft. per minute.

In conjunction with the London and South Western Railway two 30-cwt. electric jib cranes are installed on the pier at Portsmouth Harbour to deal with the Isle of Wight luggage and parcels traffic. Each crane is of special design to suit the different levels of the station ; made by Messrs. Stothert & Pitt, fitted with one 30 horse-power and one 5 horse-power Bergtheil & Young motors for lifting and slewing respectively, lifting speed 200 ft. per minute.

As a good example of the installation of a comprehensive equipment of electric cranes the Lancashire and Yorkshire Railway wool warehouse at Bradford may be cited. On every floor, and even in the cellars, there are electric travelling cranes of an ingenious type. These pick up a bale of wool, travel from one end of the warehouse to the other, and deposit the bale upon a lurry or wherever required. Wagons are loaded or unloaded from the lines in the warehouse, or from the sidings outside, the bales being rapidly transferred to the various floors.

The crane and hoist equipment of a large railway docks would provide material for a comprehensive review on its own account, and readers may be referred to numerous articles published in the RAILWAY MAGAZINE for years past dealing with that aspect. At Immingham, Great Central Railway, one finds a noteworthy system of cranes and hoists, both for general traffic and for coaling. At Hull, in the case of the King George Dock (Joint Hull and Barnsley and North Eastern Railways) the crane equipment is similarly of special interest. The quay cranes all travel on rails having a gauge of 15 ft., and have luffing jibs, giving a horizontal movement to the load. Of this type there are thirty 3-ton, four 7-ton, and nine 10-ton cranes, and six of the latter are fitted with portable elevators for discharging grain. On the roofs of the warehouses there are nine 1½-ton travelling cranes, also fitted with special luffing gear. A self-propelling floating crane of 80 tons' capacity is also available for use when required.

Twenty-five of these cranes were supplied by Messrs. Royce, Ltd., of Manchester. They are of the travelling gantry or portal type on four of the quays, each of three tons capacity.

The various types of cranes which are available may be classified as follows :—

(1) *Wall cranes*, serving a railway wagon road and a goods platform, or the latter and the yard for road vehicles, or provided for transferring goods from or to upper floors of warehouses.

(2) *Pillar cranes*, standing alone or mounted on roof columns. If these are arranged to swing through a complete circle, or the larger portion thereof, their scope of work becomes a very wide one.

(3) *Suspended cranes*, supported only from overhead, so that while they themselves can swing through a complete circle, the space immediately below is entirely unobstructed.

(4) *Walking cranes*. These are sometimes referred to as " mono-rail " or " bicycle " cranes. They may be placed against a wall with a supporting rail above attached thereto, the space for travel being only about 12 or 18 in. away from the wall, all the rest of the floor space being available for goods, over which a load can be carried while suspended. In other cases these cranes are arranged to work along a main passage-way equipped with top and bottom rails, the space required being only sufficient for the passage of the crane, which is specially built

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30-CWT. ROYCE TRANSPORTER, USED AT GLASGOW BY THE NORTH BRITISH RAILWAY.

on a narrow framing. This arrangement is preferable to the former, in that the crane can swing to either side—often through a complete circle—not only to lift or lower, but also to avoid any bulky goods which may hinder passage on one side or the other while travelling.

(5) *Overhead cranes.* These afford all the convenience of other types, but are best adapted for larger powers. They can, however, be utilised with advantage on a medium scale, one equipment or two using the same rails and working from opposite ends of a lengthy building, serving virtually the whole of the available space without obstruction below. Such cranes may be under the direction of a driver more or less continuously engaged and placed in a cage or on a platform mounted on or suspended below the main frame of the crane; or the crane movements may be controlled by hanging chains operated from ground level as required. In some cases these cranes are only employed in the open yard, other types being used in the buildings, but by providing large doors or openings and extending the supporting rails as a gantry for some distance outside the building the same crane can be made to do duty for both indoor and outdoor requirements.

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Most of these types are best suited for electric operation, one or more motors being carried on the framing, others so positioned as largely to balance a load, while the control is very simple, and no attention is required while not in use.

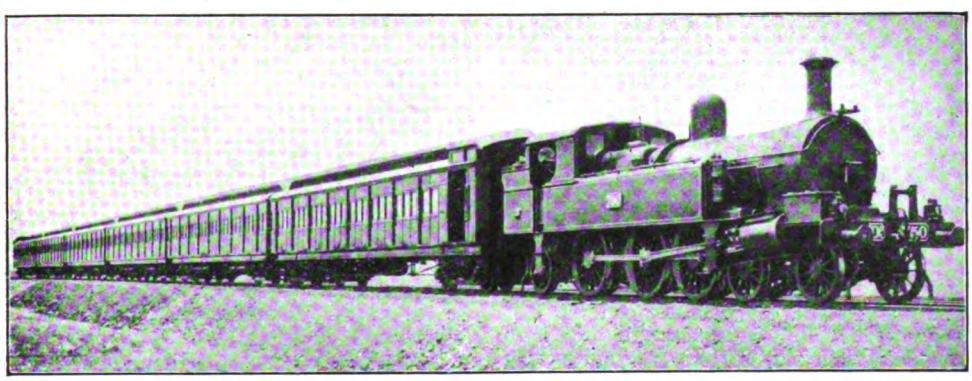
Instead of cranes an overhead runway is often of considerable value. This consists of a suspended rail upon which a traveller fitted with raising and lowering gear runs. This traveller may be adapted for hand operation, but preferably has electric motors for travelling and for raising and lowering. Where the scope is considerable a driver travels on a cage below the traveller, and the well-known installation of this type which has been in service at Victoria Station, Manchester (Lancashire and Yorkshire Railway) for many years is a good example. In that instance the rail is carried about 30 ft. above platform level, so that a suspended load can be conveyed well above some of the station offices as well as clear of the highest vehicles which may be on the roadways of the station.

The chief disadvantage is that loads can only be dealt with on the route directly served by the runway, but by locating this to pass in selected paths, probably to and fro along a building, each length connected by loops, and with curves where found desirable, a very wide scope can be given to such installations. A further development is to provide a " main line " with a number of branch lines extending into bays, and suitable designs for points and junctions have rendered entire satisfaction in practice. In many instances, too, these runways are arranged to pass through door openings, or even, where placed fairly high up, through upper windows or specially made openings so as to cross over an intervening roadway or space from one building to another.

At the Hull and Barnsley Railway Company's Neptune Street goods warehouse, Hull, there are ten Royce electrically-driven 30-cwt. jib cranes, with separate motors for hoisting and slewing, and seven Royce electrically-driven capstans (1-ton pull) with thirteen fairleads. Views of this installation are reproduced on pages 478 and 479.

Mention has been made also of the use of overhead transporters in place of ordinary crane equipment. On page 482 a view is reproduced showing a 30-cwt. Royce transporter, two-motor type, one of eight supplied for use at the North British Railway depôt in Glasgow.

STANDARD SUBURBAN TRAIN: VICTORIAN GOVERNMENT RAILWAYS.



Mr. J. H. Cherry, an Australian reader, sends a photograph (reproduced above) of the latest Victorian Government Railway's standard suburban train. The locomotive is a 4–6–2 tank engine, and has cylinders 18 in. by 26 in., and coupled wheels 5 ft. 1¾ in. diam. The Belpaire boiler is 4 ft. 5 in. in diam., contains 181 2 in. tubes 13 ft. 2 in long, and its centre is 7 ft. 6 in. from the rail-level. The firebox provides 130 sq. ft. of heating surface to which the tubes add 1,334 sq. ft., total 1,464 sq. ft. The grate area is 22½ sq. ft. The tanks carry 1,750 gallons and the bunker 2¾ tons. The weight roadworthy is 69 tons. Steam pressure is 185 lb. Total wheel-base is 31 ft. 6½ in.

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PERTINENT PARAGRAPHS

Our Frontispiece.

WITH this number of the RAILWAY MAGAZINE is presented a further addition to our well-known series of carefully prepared and well-reproduced colour plates of locomotive engines. The subject is the second of Mr. A. J. Hill's 0-6-2 tank engines for the Great Eastern Railway. In the March issue a view of No. 1000, the first engine of the class, was embodied on the folded plate, but as that engine was, and is still, painted grey and lined in black and white, for photographic purposes, the second engine, No. 1001, is now shown, as this is painted in accordance with the characteristic scheme adopted by the company. We may add that the painting from which the plate is prepared has been checked by responsible officers of the Great Eastern Railway, and their co-operation is hereby acknowledged ; and the result is the first accurate presentment of the class in the style in which it is running.

No. 1001 differs from the first engine of the class only that it is fitted with superheating apparatus—of the "Robinson" type—it being intended to institute comparative trials between the two locomotives. Both are engaged on ordinary duties in the London suburban area, working usually on the Enfield and Chingford services, or along the Cambridge line, though other routes are worked according to the links in which they are placed. It is understood that they have shown high accelerative powers, especially when working bogie trains at periods of traffic pressure on the tight schedules in force for many of the trains on the routes indicated. These new engines are fitted with "top-feed" connections, Ross six-feed mechanical lubricator, inside Walschaert valve gear, piston valves and relief valves.

The Railway Roll of Honour.

WE have before commented upon the fact that the term "Roll of Honour" is used both in reference to names of those who are serving in His Majesty's Forces and as applied to those who have given their lives in national service. A number of the special "Rolls of Honour" issued by the respective companies have been illustrated in these pages, and on several occasions we have referred to the notable contributions to the Army and Navy realised on our railways. In the 1915 *Railway Year Book* a list of the numbers contributed by 47 railways, aggregating 72,427 men, is given, these statistics being at the time of publication as nearly up-to-date as possible. But men are still joining, and the "Roll of Honour" of those who have suffered in the cause of King and Country is still being extended, and there is continual justification for further reference. A fairly recent statement by the Great Central Railway shows that 32 men from the Company's service had been killed in action or died of wounds, and their names are given on the Great Central "Roll of Honour." A London and South Western record gives 30 names of men who have given their lives. From Great Northern service, 41 men have lost their lives in the service of their country. And so one could add further statistics showing that the active patriotism of the railway service has a record of many who will never return to railway work, though they have done their duty, even to the extreme penalty.

War Honours for Railwaymen.

DRIVER C. CARTER, of the Army Service Corps, has been awarded the French "Medal Militaire pour Valour et Discipline" under the following circumstances. When under German fire, the Major called for volunteers to fetch a load of ammunition which was urgently needed for the British. Carter volunteered, although he had previously been in the saddle for about twenty hours. The medal which has been awarded to Carter is the same as that awarded to Sir John French, and carries with it an annuity of 100 francs. Carter is an Army reservist, and was employed before the war as a platelayer on the Great Northern Railway at Potters Bar.

The London and North Western Railway Roll of Honour gives particulars of five of the staff who have either been awarded the Distinguished Conduct Medal, or have been mentioned in Sir John French's despatches as follows :

H. J. Vickers, Driver, 7th Company Army Service Corps. Shunter, Traffic Department, Willesden. Awarded the D.C.M. for conspicuous gallantry at Vendresse, on September 14th, 1914.

F. Marshall, Private, Royal Army Medical Corps. Labourer, Engineering Department, Stockport. Awarded the D.C.M. for conspicuous gallantry and devotion to duty on numerous occasions.

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J. E. Healey, Private, 1st East Surrey Regiment. Porter, Goods Department, Broad Street. Awarded the D.C.M. for an act of gallantry.

P. Goode, Private, 1st Battalion Royal Welsh Fusiliers. Labourer, Wagon Department, Chester. Mentioned in despatch of January 14th, 1915, for gallant and distinguished service in the field.

W. F. Kilminster, Private, Duke of Cornwall's Light Infantry. Stableman, Goods Department, Camden. Mentioned in despatch of January 14th 1915, for gallant and distinguished service in the field.

On the London and North Western Railway the latest record shows that 12,233 men have joined the national forces. On the Great Western Railway the total is now 20,455, while over 250 others are engaged on the Company's steamers doing Admiralty work.

Mr. Guy Calthrop, General Manager, London and North Western Railway, directs attention to a report sent to him from Major G. Smith, senior works officer at Boulogne, respecting excellent work done by three men from the Great Central, Great Northern, and London and North Western Companies respectively, who are now serving with the Royal Engineers, Sapper J. Adams (Great Central Railway), Sapper H. Holland (Great Northern Railway), and Sapper G. Simpson (London and North Western Railway). On March 28th these men were detailed to check the off-loading of 2,000 sleepers from the s.s. *Algama*. They began work at 7 p.m. At 11 p.m. the French labourers on the quay struck work and went off to bed. The sleepers had to be piled in a particular place and had to be dumped first on the quay, and then carried a short distance and stacked. The three Sappers, when their labour went off, continued the work, and by 6 a.m. had piled, themselves, about 1,500 sleepers. As they had been ordered to check only, this was a fine zealous performance, in accordance with the best traditions of the Corps of Royal Engineers.

The Influence of the War on Railway Working.

WHETHER we shall ever be favoured with reasonably complete details as to what our railways have done since the outbreak of war is doubtful, though such a record should be of exceptional value and would include a great deal of interesting material. For the present it is only possible to deal with incidental aspects, coupled with such information as to numbers of trains operated and so on which may be made public from time to time. Many facts have, however, revealed themselves as to peculiarities of locomotive and train working, and some of these may be briefly referred to, especially as, while of interest to students of railway matters, they can possess no possible value to the enemy.

It is quite usual now to see goods trains made up of wagons belonging to many railways, some including lines whose vehicles are rare visitors to the railway where they are seen. For example, in the latter half of a Great Eastern goods train—the first portion had passed from view—we noted quite casually wagons belonging to no fewer than nine railways: Great Eastern Railway, Great Central Railway, Great Northern Railway, Great Western Railway, London and North Western Railway, North Eastern Railway, Furness Railway, Hull and Barnsley Railway and North British Railway, the last three being decidedly unusual in the neighbourhood of Stratford. This variety is also seen in other respects, as, for instance, a Midland truck covered with a North British sheet; all indicative of a degree of "pooling" of material. The explanation is that, while one can hardly say that everything is "pooled" in the ordinary sense, the suspension of individual ownership and Clearing House arrangements allows of wagons being used with relative freedom, and when a vehicle arrives from another line it can be utilised wherever it may be, instead of being worked back at once.

"Foreign" running of Trains and Locomotives.

It is not so often that coaching stock works on to other lines except with troops or otherwise on Government service; hence passenger trains and locomotives where they appear other than on their own lines are usually working "specials," though in many cases they are worked forward without change of engine where under ordinary circumstances such a change would be made. The most unusual instance of special working which we have come across occurred a month or so back, when a West Coast train from Edinburgh was sent through to King's Cross instead of Euston, over the North British, North Eastern and Great Northern Railways, and hauled by their engines. On goods trains, however, locomotives frequently work on to other lines, and it is by no means unusual for them to remain there for several days, doing ordinary work, until it is convenient to work them back again. To quote one example, we understand that both London, Brighton and South Coast and Midland engines worked recently on the Great Eastern Railway for about a week, thereby assisting to relieve a congestion of goods traffic, though they originally appeared on special trains from their respective lines and about a week later worked back in a similar way.

A further instance of special working is afforded by the temporary transfer of several Hull and Barnsley locomotives to the South Eastern and Chatham Railway, the suspension of part of Hull's trade rendering these engines available to assist the heavy pressure of traffic on the latter system. They are working ordinary trains, and their appearance has aroused considerable interest on the South Eastern and Chatham Railway. The unfamiliar initials have received many curious interpretations, the strangest being that they signified "Highland and Brecon," though why these geographically remote names should be selected we are at a loss to determine.

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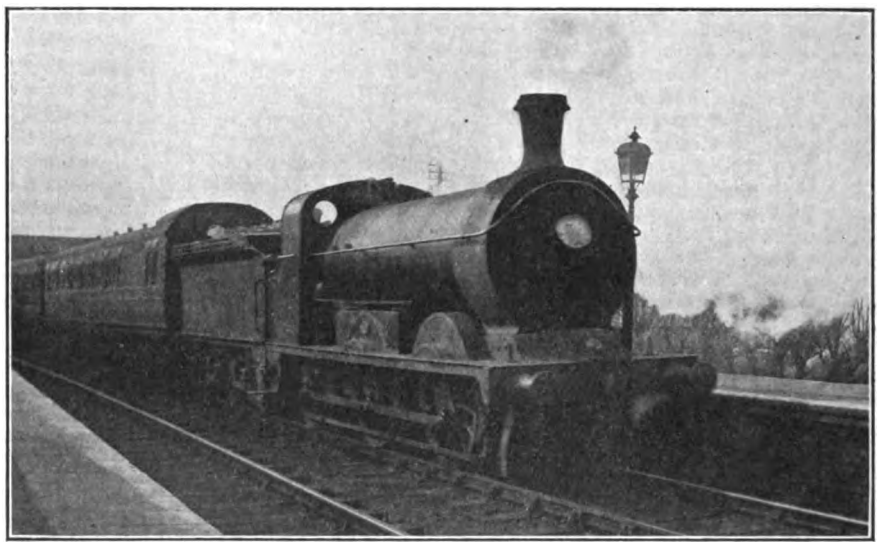
Public Aspects of Railway War Problems.

SPEAKING generally, there is an almost universal acknowledgement that the conduct of our railways since the outbreak of war, under the direction of the Railway Executive Committee, has realised a standard of success which might well be envied by other Government undertakings; but in a few matters an under-current of adverse criticism has manifested itself. One of these is the support given by our railways to such of the race meetings as have been held, and seeing that in certain instances such criticism has been coupled with complaints that not only general public traffic but also Government and military traffic has been seriously inconvenienced thereby, it is only right that the subject should be properly investigated. This, we understand, is being done, though it is very doubtful whether the case is anything like as bad as alleged; but meanwhile Sir Herbert Walker has issued an explanatory note in the following terms:—"The attitude of the railway companies with regard to racing is that, while not encouraging it by the issue of cheap tickets, we are bound to carry passengers who present themselves at the stations, and are prepared to pay the ordinary or, as was the case on Saturday, the special high fares. The reason for running special trains is simply to prevent the overcrowding of the ordinary service, which without such relief would become chaotic. It is no part of the duty of those responsible for the management of the railway companies to say whether racing shall take place or not. That is a matter for the authorities and the public. The specials run in connection with Hurst Park races did not amount to a tithe of those run for Military purposes."

"Air Raids" and the Railways.

ON the occasion of the air-raid on Blyth and Wallsend which took place on April 14th, one of the bombs dropped near Wallsend fell on the railway, narrowly missing a train full of passengers journeying to Newcastle on the Tynemouth line. At Newcastle the lights in the streets were extinguished and the electric current was cut off. Tramway-cars were brought to a standstill, and the entire city was in darkness. The railway station was closed. An East Coast express was stopped in the station, and the railway traffic generally was delayed, as a number of the trains would have had to pass through the danger area. By 11 o'clock, however, it was realised that the danger was over, and railway traffic was resumed. The railway service generally in the North was not seriously interfered with, and at York the service was normal.

In the early morning of April 16th an airship dropped three bombs at Lowestoft. Damage was done to house property, and a timber yard was set on fire. Three horses belonging to the Great Eastern Railway were killed. At Southwold six bombs were dropped; one fell on a railway truck and set it on fire. The same morning several other parts of the Great Eastern system were visited, and again on April 30th, but the damage to railway or other property was relatively little, and no injuries to people are recorded.



Photo] [*H. G. Cogger.*

SLOW MAIN LINE TRAIN, SOUTH EASTERN AND CHATHAM RAILWAY, WORKED BY HULL AND BARNSLEY 0-6-0 LOCOMOTIVE NO. 87.

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In reference to the air raid on Ipswich and Bury St. Edmunds it has been stated, probably with a degree of newspaper exaggeration, that the proceedings included "a mad neck-to-neck race between the airship and a Great Eastern train near Bury St. Edmunds." The report continues that "as the train dashed along at top speed, the Zeppelin hurled five bombs at the rushing train below. All the missiles fell wide of the mark, and the train steamed into Bury St. Edmunds unscathed."

Troop Transportation in Canada.

In connection with the transport of the Canadian forces, the Grand Trunk and Grand Trunk Pacific Railways realised some exceptional performances. Canada's first and second contingents totalled over 50,000 men, and these railways were called upon at short notice to provide transport facilities for large bodies of troops, commissariat, guns, horses, and general equipment, most of the movements being over long distances. The general plan followed was the concentration at mobilisation points of the various local units. The military authorities afterwards made arrangements with the railways for the movement of the troops to the various training camps and ports of embarkation. Special trains were utilised for this work, and exceptionally fast runs were made, while ordinary traffic went on as usual. From Prince Rupert, British Columbia, to Halifax, Nova Scotia, is a run of 4,000 miles, and for these long journeys from Western Canada to the Atlantic seaboard the railway fitted out special commissariat cars, with ample kitchen accommodation. These were attached to the troop trains and provided meals for the soldiers *en route*.

The movement of troops was completed without an accident, the time schedules being closely adhered to. The Grand Trunk system, during the period that the troops were at the mobilisation points, authorised the sale of special reduced fare tickets to officers and men of the units to enable them to visit friends and relatives. This proved to be a boon to the men in training, many of whom were anxious to pay farewell visits to their homes in uniform before sailing for Europe. Arrangements were also made whereby tickets were issued on request to reservists of the British forces, and also to men subject to service in the Allied Armies of France and Belgium. The reservists were not required to pay cash fare, but merely to submit some proof of their identity whereupon transportation, and meal tickets, in many cases, were furnished. These arrangements facilitated very greatly the rapid mobilisation of the widely scattered veterans of the three armies. The Grand Trunk and Grand Trunk Pacific also rendered considerable aid to the Belgian Relief Committees, carrying free of charge over their lines and in the Canadian express cars all parcels of clothing and consignments of food donated for the amelioration of suffering in Belgium. Soon after the declaration of war the Canadian railways inaugurated, with the help of the Military and Police authorities, an effective patrol system for the protection of the bridges, tracks, works, and station buildings.

The Grand Trunk and Grand Trunk Pacific Railways announced on the outbreak of hostilities that all men enlisting for over-seas service would be carried on the pay-rolls of the company for six months on full pay, and that their positions would be open for them on return to civil life. After six months on full pay the men who enlisted are being given half-pay for a further period. Some 700 men from the two railways have enlisted, and are in the firing line in France or preparing for such service. They include all ranks, and represent all branches of the railway service.

Canadian Overseas Railway Construction Corps.

In connection with a scheme for utilising Canadian enterprise in the operations of the war, the War Office recently asked the Dominion Government to arrange for the recruiting in Canada of a force of about 500 men for railway repair and reconstruction work in Europe during the continuance of the war. At the request of the Dominion Government, says the *Canadian Railway and Marine World*, the Canadian Pacific Railway management, through the President, Sir Thos. G. Shaughnessy, undertook the organisation of such a corps. This organisation has been placed in the charge of Mr. C. W. P. Ramsey, Engineer of Construction, Canadian Pacific Railway Eastern Lines, Montreal, who has been granted extended leave of absence and who ranks as lieutenant-colonel in command.

The force, which is being mobilised at St. John, N.B., has a regimental staff comprising the commanding officer, who ranks as lieutenant-colonel; a chief engineer and a quartermaster, as majors; and an adjutant, paymaster, and medical officer, who rank as captains. The corps is divided into two companies, A and B, each under the command of a major, who is superintendent of construction, with a captain as second in command, the captain of A company being bridge engineer, and the captain of B company being general foreman of repairs. Each company is divided into two platoons under the command of a lieutenant, one of whom in each company is assistant engineer and the other assistant to the adjutant. The strength of each company outside of the officers is 252 men. Under each platoon commander is a sergeant drill instructor, who provides for the military instruction under the supervision of the platoon commander. For working purposes each company is directly under the command of the company major, who, as above stated, is superintendent of construction. The right platoon of each company consists of a locomotive crane crew, blacksmith crew, telegraph crew, timber trestle crew, bridge derrick car crew, and three labour crews. The left platoon consists of track pile driver crew, portable pile driver crew, track laying machine crew, concrete mixing crew, steam shovel crew,

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work train crew, and two labour crews. Each company also has a dining car crew. The Canadian Pacific Railway has given official notice as to the special terms offered to the 507 skilled railway constructors thus enlisted, and the grades of each member. In addition to the regular rates of pay specified, certain working allowances are made for the various classes of skilled men in accordance with position and ability.

Over the Trans-Siberian Railway under War Conditions.

An American contemporary, the *Chicago Daily News*, publishes an interesting letter in which the writer, Mr. Bassett Digby, describes his experiences while travelling over the Trans-Siberian Railway on a journey from Vladivostock to Petrograd, under war conditions. A few extracts may be quoted :—

"One passenger train, consisting of half a mile of cars, left Vladivostock daily for the west, being hauled at a snail's pace by an antiquated locomotive. All the good locomotives in Siberia have been requisitioned for service in Russian Poland, and an extraordinary collection of Belgian, German, Russian and American locomotives is attempting to cope with traffic. The engineers are uniformed soldiers, and the trans-Siberian Railway is now a military line absolutely, there being only one passenger and mail train daily. Extraordinary precautions are taken to safeguard the enormous supplies of troops, horses and guns that have been sweeping over the line day and night since early in August and that as yet show no sign of abating. Every bridge from Vladivostock to Petrograd is picketed by troops and the tunnels are lined with sentries.

"In spite of the strict official reticence, I learned that many attempts have been made by German agents to blow up the long many-spanned bridges over the great rivers of northern Russia. Every passenger train nearing a multi-spanned bridge is boarded by a squad of Cossacks, armed with rifles, bayonets and revolvers. The passengers are told to move away from the windows and sit down with their hands visibly folded in their laps. Two efforts have been made to blow up the great Sungari bridge at Harbin. A train attendant told me that an attempt made by the Germans to blow up the Kama river bridge near Perm had been narrowly frustrated. The journey from Vladivostock to Irkutsk was extremely slow. There was no set schedule, and the train was constantly sidetracked to permit the passing of troop trains, a great quantity of artillery, gun carriages, transport carts and pontoons appearing as if by magic from the deserted steppe and forest regions, in the fastnesses of which Russia has been establishing barracks and populous military settlements unsuspected by foreign observers."

Travellers' Difficulties.

"It was extremely difficult," continues Mr. Digby, "to leave Irkutsk. From the expression of the railroad station authorities I might have asked for a rare orchid or a jewel instead of an ordinary ticket. It was impossible for me to get a ticket directly, but I was referred to a mysterious person named Michael, who, it appeared was omnipotent in such affairs. The details about Michael and his procedure were rigidly withheld, and I began to suspect that it was a subtle hint to pray to the archangel of that name until I discovered that he was a hotel porter in Bolachaya Street. It is difficult to get first or second-class tickets on the daily train, but Michael had a graft system. He was in league with clerks in the ticket office, rendering it impossible for anyone to leave the Siberian metropolis without approaching him with due humility and much money. It cost me $15 to gain permission to buy a $35 ticket. Many poor and respectable people had been trying in vain for a week to buy tickets legitimately.

"Winter had set in when I left Irkutsk. The temperature was at zero, there was deep snow and the rivers were ice-bound. Electric arc light standards set in the ice near the bridges aid the sentries in their vigilance against bomb throwers. It took five days to reach Omsk, the normal time being two days. There was no diminution in the number of troop trains. During the long waits at the sidings the Russian officers went out on the snow for revolver practice, shooting at bottles thrown into the air. The government is posting war bulletins at every station, and villages situated from 300 to 400 miles north and south of the railroad have instituted a system of daily couriers, who come in by sledge, read the bulletins and return with the news. These villages in turn pass on the tidings to the remoter villages. The trans-Siberian road is the agency which is keeping Siberia informed as to the progress of the war."

A Railway Staff Conference.

Railway officers' conferences are standard features of railway management ; but on March 19th a meeting was held at Liverpool Street, of which particulars are given by our Great Eastern contemporary, and which was certainly unique so far as the Great Eastern Railway is concerned, and probably was the first of its kind in this country. It consisted of about 200 members of the staff of the chief traffic manager's department, and included head office staff, station-masters, goods agents, canvassers, and, in fact, was a thoroughly representative meeting of all sections of the department. Mr. Wm. C. May, Chief Traffic Manager, was present, and occupied the chair, but only for the purpose of explaining the objects of the meeting. In his introductory remarks, he said : "The idea of a meeting of this description came to me about this time last year, when I was in America. In a room rather larger than this there were gathered about 320 'freight solicitors' and agents. They were, I believe, principally goods canvassers, but some few—and they appeared more as visitors than otherwise—were passenger men. Now I thought about that meeting a lot afterwards, and it

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occurred to me that it would be a good idea to have a similar gathering, at least once a year, so far as the traffic departments of the Great Eastern were concerned. There are, and must necessarily be, a very large number of subjects in common to all of us. There are many, of course, which relate only to the goods section of this department, and there are numerous subjects purely relating to the passenger section, but all these may, in my opinion, be profitably discussed by all of us and helpful information gained by those gentlemen who represent one side taking an intelligent interest in the problems which confront the other side, and *vice versa*. . . . A short time back I issued a notice, which, for want of a better name, was called 'Monthly Note to Staff,' and I propose to issue that monthly and regularly, and we at Liverpool Street will try and put into that note any item of interest or anything which may be useful to the staff generally, but we should also like you to suggest any matters which you may think might be profitably included so that any knowledge which any group or any one of us has, can be imparted to all others in the department and all benefit thereby."

The meeting then continued under the chairmanship of Mr. Newman, and the following subjects were discussed :

(1) New Passenger Train Service.
To consider its relation to public needs.

(2) Shortage of Staff at Stations (Goods and Passenger).
Suggestions invited.

(3) Women Clerks.
(*a*) Booking clerks.
(*b*) At large goods stations for abstracts and preparation of accounts.

(4) Congestion Difficulties.
(*a*) Reduction of free time for unloading.
(*b*) Other remedies invited.

(5) Map or Handbook for Canvassers and Public.
To show Great Eastern routes with stations throughout Great Britain.

(6) Starting Passenger Trains.
Suggestions that guards should have authority to start passenger trains from certain stations without waiting for a signal from the station staff.

(7) Road Competition (Goods and Passenger).

(8) Provision of Baskets to Facilitate Transit of Small Parcels.
Criticism and suggestions invited.

(9) General Issue of Market Tickets.

LONDON, BRIGHTON AND SOUTH COAST RAILWAY SCHOOL AT EAST CROYDON FOR TRAINING GIRLS FOR RAILWAY CLERICAL AND STATION WORK.

A Training School or Feminine Service on Railways.

FEMININE ticket-collectors, dining car attendants, clerks, carriage cleaners, etc., have now appeared as definite features of railway working ; and in order to meet the needs of the situation in this respect the London, Brighton and South Coast Railway have established in the Signalling School at East Croydon a school for training girls for telegraph, booking clerks' duties, and general office work. The instructress is Miss Strevett, daughter of the stationmaster at Hailsham, who many years ago entered the service as booking clerk at that station, and is therefore acquainted with the work. A general view of the school is reproduced, and it will be seen that the girls are grouped in classes, some doing clerical work, others telegraphing from one end of the room to the other, a further party is learning the Morse alphabet, while a fully equipped ticket office, fitted with small ticket classification book, enables instruction in this part of the work to be given.

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Locomotive and Train Working in the latter part of the 19th Century.

THAT Mr. E. L. Ahron's articles under this title are appreciated is shown by the volume of correspondence created. A further letter, from Mr. Reginald H. Coe, dealing with the London and North Western sections, may be quoted. He writes :—

"I was living in Birmingham at the time when the day of the 'Webb' compounds and the 'Lady of the Lake' class was just drawing to a close and can furnish one or two notes on these locomotives that might be of interest. In the summer of 1903 all the 'Teutonic' compounds were at Rugby and were usually engaged in main line work between Crewe and Euston. One of them, however, always hauled the 4 p.m. Harwich boat express from Birmingham to Peterborough. I believe that the world-renowned *Jeanie Deans* was the last compound to work this train, which, by the way, was principally made up of Great Eastern coaches and ran right through to Harwich, thus forming an important link between the Midlands and the Continent.

"I was once at Marston Green, a small wayside station about 8 miles from Birmingham, and saw *Adriatic* come tearing through in gallant style, with quite a respectable load. In those days we were always able to distinguish a compound at a distance, by the peculiar noise it made when puffing, but I have no idea why the noise should have been any different from an ordinary engine, except that there were only two exhausts per revolution. This noise, which somewhat resembled a double-puff, was always more apparent when the engine was getting up speed. After the withdrawal from service of the 'Teutonics,' the afore-mentioned 4 p.m. from Birmingham was almost regularly hauled by the 2–4–0 engine *Cook*, No. 1529, which had been stabled at Rugby for an unknown period of time. *Cook* was transferred to Llandudno in 1911 and the same year met its 'death' at Ditton Junction, where it was completely smashed up.

"To return to the compounds, there must have been a good few 'Dreadnoughts' at Rugby in 1903–4, for they were most frequent visitors to Birmingham at that time and I well remember seeing the following in New Street station, all bearing Shed 8 plates :—507 *Marchioness of Stafford*, 545 *Tamerlane*, 638 *City of Paris*, 644 *Vesuvius*, 1379 *Stork*, 2057 *Euphrates*, 2060 *Vandal*, 2061 *Harpy* and 2064 *Autocrat*.

"The 'Experiment' and 'John Hick' classes were rare sights in the Midlands, though a 'John Hick' sometimes worked up to Euston. The 'Greater Britains' were more common and one was sometimes even seen on the Stafford–Birmingham section. *Greater Britain* herself—then stationed at Crewe—once took the 3.30 p.m. express from Birmingham to the North, with a rather heavy load. Despite the reputation for starting that the 'Webb' compounds have got, I recollect that *Greater Britain* climbed the incline out of New Street station in admirable manner; whereas I have often seen one of the modern 'Precursors' and even the six-coupled 'Experiments' almost brought to a standstill on the stiff rise out of New Street."

WOMEN TICKET COLLECTORS: LONDON, BRIGHTON AND SOUTH COAST RAILWAY.

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The last days of the Webb "Singles."

"RIGHT up to the very last," continues Mr. Coe, "the 'singles' were every-day sights in the Midlands, and during the years 1904–6 I saw many of them in the vicinity of Birmingham. Before the introduction of the 'Precursors' the London-Birmingham 2-hour expresses were always hauled by the then new four-cylinder compounds, but it was soon found that these 'crack' trains were too much for a 'Jubilee' or 'Alfred the Great' to tackle single-handed, and two trains in particular, the 4.55 p.m. and 6.55 p.m. from Euston, were almost invariably double-headed. The pilot was usually one of the 'Ladies,' and I have known a four-cylinder compound, headed by a 'Lady,' arrive at Birmingham before time with a heavy load, which shows that, whatever may have been the shortcomings of these old steeds, they could still manage to 'get along' when put to it.

"A good many of the 'Lady of the Lake' class finished up their careers on the Chester and Llandudno section, and in the summer of 1905 I saw quite a lot whilst staying at Rhyl. I have not, unfortunately, the names of all I saw then, but they included the following, all of which were stationed at Chester:—No. 1 *Saracen*, 28 *Prometheus*, 234 *Mazeppa*, 291 *Prince of Wales*, 719 *Outram*, 804 *Soult*, 827 *Victoria*, 833 *Clyde*, 834 *Elgin* and 1435 *Fortuna*. The most famous 'single' of the whole batch—*Lady of the Lake* herself—I last saw in 1906 at Shrewsbury, where she had been stationed for some time. She was broken up the same year. 218 *Wellington* was for some years at Birkenhead and left that shed, I think, in 1901.

"Many bitter things have been said about the 'Webb' compounds, but personally I have heard of many of them making some very good runs. The 'Dreadnoughts' and 'Teutonics' in particular accomplished some very fine performances, and like Mr. Ahrons I much regretted the early scrapping of the latter type."

In reference to this letter Mr. Ahrons writes that he is interested to learn that in 1903 the "Teutonics" were working the Harwich boat train from Rugby to Peterborough, and appreciates this evidence of interest aroused by his articles. He points out, however, that to trace out the working history of every engine would be impossible, and he only intended to deal with main features and with such aspects as came under his own notice from 20 to 30 years ago.

Widening Works on the Glasgow and South Western Railway.

FROM Glasgow to Dalry, a distance of about 23 miles, the two routes through Paisley, one over joint line *viâ* Gilmour Street, and the other *viâ* Paisley (Canal), and the routes beyond through Johnstone and Beith and through Lochwinnoch and Kilbirnie, give approximately four-track facilities, but it is not until Kilwinning Junction is reached that traffic becomes sufficiently distributed to render the provision of two tracks adequate, and powers were obtained some time ago for doubling the line between Dalry Junction and Kilwinning.

Dalry Junction, where the widening begins, is the junction at which the traffic for the Ayrshire coast leaves the main line to Kilmarnock. Kilwinning, where the widening ends, is the junction for the Ardrossan and Largs lines. The new works apply for a distance of about three miles. Four overbridges were removed altogether, and new bridges erected over the widened lines. The new bridges were built adjoining the old ones which were left standing until the new structures were opened for traffic. The old bridges were taken down on Sundays, when the cast-iron beams were removed by cranes and the arch bridges were blown up with gelignite. All the new overbridges have brick abutments, built with cement mortar, and faced with Accrington Nori-plastic engineering bricks. The superstructures are of ferro-concrete built on the Considere system. The square spans of the new bridges are 53 ft., and the width of the roadway between parapets varies from 12 ft. to 30 ft., the latter being on the bridge carrying the main public road between Dalry and Kilwinning over the railway. It has a skew span of 67 ft. 3 in., and before being opened for traffic this bridge was tested by two 20-ton traction engines going over it both tandem and abreast at a speed of 3 miles per hour.

There are several underbridges, one for an accommodation road and the other carrying streams under the railway. The old bridges were built with stone, and they have been extended with abutments and arches of brickwork similar to the new overbridges. The earthworks are not of a heavy nature, the greatest depth of cutting being 28 ft. and of the embankment 28 ft. The completion of this widening will give four lines of rails between Glasgow and Kilwinning, a distance of 26 miles. The engineer for the work is the Company's engineer, Mr. William Melville, M.Inst.C.E., and the contractors are Messrs. Hugh Symington & Sons, Ltd., Glasgow.

The "Unusual" in Railway Practice.

As a rule, railway traffic is conducted on more or less well-defined and orthodox lines, and even the special developments of the War have not altogether altered this, at any rate as regards locomotive working. But there are continually arising conditions which introduce unusual features, and as we have been favoured recently with several photographs showing special or peculiarly interesting features of traffic working, four are reproduced as a group on page 492. Mr. Felix E. Jones sends "A Curious Combination," photographed at Handsworth and Smethwick station, and showing one of the large Great Western two-cylinder 4–6–0 engines, No. 2902, *Lady of the Lake*, attached (presumably for traffic reasons) in the front of a saddle tank engine No. 2176, on a local train. The other three illustrations are sent by Mr. R. Hall, of Baldock, who is now serving in the Public

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Photo] [*R. Hall.*

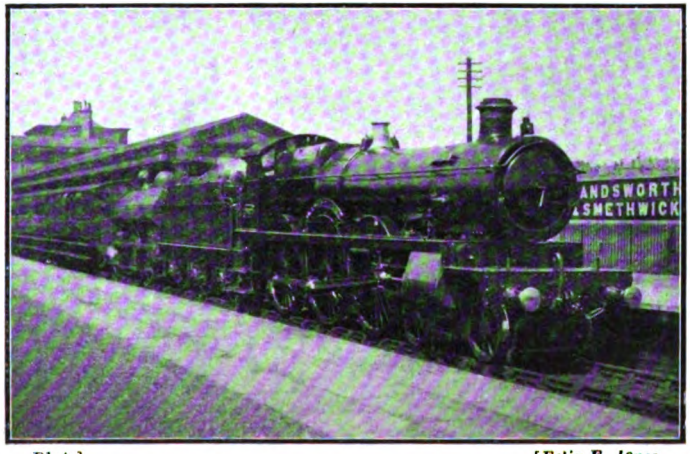
TRAIN OF HORSE BOXES FOR HARPENDEN RACES.
Worked annually by a Great Eastern engine over the Great Northern Railway. The photograph was taken at Baldock.

Photo] [*R. Hall.*

GREAT EASTERN RAILWAY 2–4–0 LOCOMOTIVE NO. 464 WORKING 8.30 A.M. GREAT NORTHERN TRAIN FROM CAMBRIDGE TO HITCHIN.

Photo] [*R. Hall.*

DOWN NORTH EASTERN RAILWAY SPECIAL TRAIN ON GREAT NORTHERN RAILWAY, NEAR STEVENAGE.
3-cylinder superheater 4–4–2 engine No. 2170.



Photo] [*Felix E. Jones.*

A CURIOUS GREAT WESTERN COMBINATION.
No. 2902 *Lady of the Lake* and saddle tank engine No. 2716 in Handsworth and Smethwick station.

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Schools' Brigade, Royal Fusiliers, and stationed at Epsom. In one, a special North Eastern train, worked by one of the new three-cylinder superheater "Atlantics," No. 2170, is shown at Wymondley Siding, near Stevenage. It had worked a special train to London on August 1st last, and returned from King's Cross just before 3 p.m. No. 3 is explained by the fact that at Cambridge an engine off the road blocked the Great Northern engine shed, and consequently the 7.40 and 8.30 a.m. trains to Hitchin, and the 9.50 a.m. and 12.2 p.m. return trains, were worked respectively by Great Eastern mixed traffic engines Nos. 453 and 464. The latter engine, on the 8.30 a.m. from Cambridge, is shown near Baldock. The remaining view shows Great Eastern engine No. 454 working a special train of horse boxes for Harpenden Races. This trip is made once a year to maintain running arrangements.

Signalling Possibilities.

FEW signalling papers have created so much interest as that contributed by Mr. A. F. Bound, Signal Engineer, Great Central Railway, to the Institution of Signal Engineers, his subject being "The Art of Signalling and Some Suggestions." A third meeting was devoted to discussion, and still a fourth is to be arranged to hear the author's reply. At the third session the President (Mr. A. Hurst) succinctly summarised the discussion as a whole by placing them in three classes: (1) Those concerned with railways having traffic of all kinds, and who, therefore, appreciate the elasticity of the block system, though it is attained by the addition of complicating rules and regulations and adjuncts, some of them described by another speaker as a "choice of evils"; (2) those in the service of railways where passenger traffic counts for more than goods traffic, and who may therefore find track circuit entirely satisfactory; and (3) those concerned with "intense-traffic" lines, where automatic signalling and track circuit are necessarily employed. There are also the two schools—"lock and block" and "track circuit"—each inclined to lay special stress upon the advantages of the policy favoured and the disadvantages of the alternative. But notwithstanding the many points of interest raised, it is very doubtful whether any great changes will be realised, and probably signal engineers will proceed more or less as they were doing, track-circuit installations being added in large numbers as traffic justifies them, while the standard features of signalling practice are retained though in continual process of improvement and development. Mr. Hurst passed some valuable comments upon certain aspects of the visual signals. He considered that the high speed observance of three signal positions, as advocated in three-position signalling, would add considerably to a driver's responsibilities, though it may be suggested that this difficulty would largely remedy itself with usage. Mr. Hurst also expressed the opinion that, could we begin afresh, the upper quadrant would be selected by most engineers for the movement of the signal arm. He also laid stress upon the fact that the 45 deg. position of a signal arm is more confusing than an angle of 60 deg. is a good one.

An interesting point is that, notwithstanding certain disparaging remarks, stress was laid upon the value and importance of the human element in railway signalling. The general opinion appeared to be that the initiative and intelligence of the human agent is a valuable factor, and adjuncts and safeguards should be auxiliaries rather than superior influences. Considerable emphasis was laid on the fact that, whatever may be the value of mechanical safeguards, signalmen and others have avoided by intelligent action as many, and probably more accidents than have been attributed to failure of the human element.

Interlocking Points and Signals.

A NOTEWORTHY paper on this subject was recently given before the Junior Institution of Engineers by Mr. T. S. Lascelles. In early days accidents arose through the pointsman turning off a signal and forgetting to turn the points correctly, and eventually the practice of working the points from the same spot as the signals came into use. Even here there was a source of danger, for it was still open to the pointsman to make mistakes, by turning off contradictory signals or exhibiting signals at variance with the points. To overcome this, interlocking was introduced. Saxby, at Bricklayers' Arms, and Austin Chambers, at Kentish Town Junction, were among the earliest at the work. Interlocking developed and was applied extensively from 1860 onwards, but in 1889, after the Railway Regulation Act, and following the terrible Armagh disaster, its use became compulsory. Locking frames adopted fell into two classes, those in which the locking was actuated by the movement of the lever itself, and those in which it was operated through the lifting of the trigger or catch-handle of the lever. The tappet principle is now universally adopted for interlocking the levers. In addition to the locking and releasing of one lever by another, or by others, in modern signalling, "special" interlocking is used, in which levers interlock with one another conditionally on the position of other levers at the time. The Board of Trade stipulate certain requirements to which the locking in every signal-frame must conform. Points form a very important part of a signal installation. They are worked by rodding, which has to be compensated for changes in temperature, and, in the case of facing points, arrangements are made for securely locking them during the passage of a train, and before a governing signal can be lowered. All points over which an important move is made are also fitted with detectors to ensure their being in the correct position in obedience to the lever before a signal is lowered.

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THE fifty-seventh annual dinner of the Railway Benevolent Institution was held at the Whitehall Rooms, Hotel Metropole, on May 4th. Apart from the claims of the Institution, which appeal strongly to directors and officials, the annual dinner gives railwaymen from all parts of the country a chance of meeting together, outside conference and other business gatherings. That Mr. A. E. Mills, the Secretary, was able to announce subscriptions amounting to £9,442 sufficiently indicates that there has been no slackening in the efforts made to support the valuable work done by the Society. The Right Hon. Lord Balfour of Burleigh, K.T., a Director of the Great Northern Railway, presided. Among those present were chief officers of nearly all the leading railways, this function being, indeed, one where perhaps more of our chief railway officers are brought together than any other. Tables other than the Chairman's were presided over by Messrs. J. Tatlow, Wm. C. May (Chief Traffic Manager, Great Eastern Railway), I. T. Williams (Chief Goods Manager, London and North Western Railway), A. Beasley (General Manager, Taff Vale Railway), W. J. Grinling (Chief Traffic Manager, Great Northern Railway), A. Aslett (Secretary and General Manager, Furness Railway), and Mr. A. E. Mills (Secretary to the Institution). In the course of his remarks Lord Balfour of Burleigh spoke of the work of the Institution, and mentioned that last year there were nearly 6,000 grants, an average of about 113 a week. The Institution administers an income of about £77,000 a year, partly derived from interest on invested funds the results of the providence of past times, partly raised by subscriptions from officers and servants themselves, partly by contributions from outside sources, and partly the product of the annual appeal we are met here to-night to give support to. Mr. Ammon Beasley, as Chairman of the Board of Management, replied to the toast of the Institution, and mentioned that at the present moment there are 349 officers and servants and 841 widows receiving permanent annuities, a total of 1,190 ; and since the inception of the Institution in 1858 no less than 2,805 have received and enjoyed those permanent annuities. At the present time the cost of these is about £20,000 a year. The contingent annuities for the 1,414 recipients cost even more than that ; coupled with grants made to alleviate immediate distress they cost over £24,000 a year. These contingent annuities are dependent on current subscriptions and donations, which naturally vary from year to year. In all, the Institution is responsible for no less than 2,604 annuitants. Then there are the orphans which the Institution takes care of. There are two grades of orphans—those of the uniform grade and those of the salaried grade. Those of servants are provided for in the Orphanage at Derby, and those of the salaried staff are educated and maintained by payments made to the parent or guardian where the child attends a school approved by the Board. Other speakers were Mr. Balfour Browne, K.C., and Sir Frederick Green.

* * *

THE annual re-union of railway employés, in aid of the Irish branch of the Railway Benevolent Institution, was held in Dublin, on April 15th. It consisted of a dinner, followed by a smoking concert. The annual dinner was held at 6 p.m. Mr. Joseph Tatlow presided over a large company, amongst whom were many leading railway officers associated with the Irish lines. Mr. P. J. Brady, M.P., in proposing "The Irish Branch of the Railway Benevolent Institution," said it would be difficult to find a charitable society with stronger claims on the public purse strings than the Railway Benevolent Institution. Merely to state its objects was to prove that. It provided for men injured by accident, disabled by old age and other causes, and for the necessitous widows of railwaymen, and maintained and educated their orphan children. In 1912 Irish railways carried 29,162,404 passengers. During the last six months thousands upon thousands of soldiers had been carried *en route* for various ports of embarkation to take their places in the fighting line, and all that had gone on day after day, and they had not heard of any single mishap or disarrangement. Railway employés had been doing their duty just as much as the gallant soldiers were doing theirs on the battlefields of France or Flanders. But although railway accidents were rare amongst passengers they were, unhappily, not rare amongst railway officials, and many a man in the railway world had gone to his death for the very purpose of avoiding a greater catastrophe to the travelling public on whose behalf he was working. The record of the Irish branch since its foundation in 1891 had been one of continued and steady progress. Its income in 1892 was

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£727 ; last year it was £2,746. Since its foundation it had paid in annuities £9,711, in school benefits £4,048, and in gratuities £2,201. Under the Special Benevolent Fund it had paid £6,088. He was glad to be able to announce that a very large percentage of Irish railway employés had joined the Colours, and a special resolution of the Institution was adopted that the absence of these men serving their King and country was not to prejudice their claims on the Institution, even if their subscriptions were in arrear. He wanted the collection for 1915 to break all previous records. All the Irish railways had played a prominent part in the conduct of the war. Troops in large numbers had been carried over all the Irish systems. Some companies, by reason of their area, such as the Great Southern and Western Railway, might have carried more soldiers than others, but all had fulfilled whatever was required of them. In the case of his own Company, the Midland Great Western Railway, one should remember that it was the principal live stock carrying Company in the country. The food supply of the Army beyond the seas had been, as it always was, of course, one of the most important factors in Military administration. On all sides one heard of how well this branch of the work had been done in the present campaign. Mr. J. Bagwell, General Manager, Great Northern Railway of Ireland, in acknowledging the toast, which was cordially honoured, paid tribute to the services rendered to the Institution by Mr. Tatlow and the late Mr. Charles Smith, whose presence they all sadly missed that evening. The Institution was doing splendid work, and was proving a real assistance to many deserving railway servants. He hoped that as the result of the reunion the Institution would enlist on its behalf many new friends.

* * *

ALTHOUGH it has been influenced by the war, the London and North Western (London) Athletic Club Amateur Operatic and Dramatic Society realised conspicuous success on the occasion of their first operatic performance (proceeds devoted to War Funds), which took place at the Cripplegate Theatre, Golden Lane, E.C., on Monday and Tuesday, April 19th and 20th. The Society had selected Gilbert and Sullivan's nautical comic opera, "H.M.S. Pinafore," and this choice, judging from the standard of rendering realised, the zest and skill with which the performers took their parts, and the enthusiasm aroused by the audience, was abundantly justified. The orchestra was provided by a contingent of the Central London Orchestral Society, conducted by Mr. David J. Thomas, and the whole performance went with splendid go and without a hitch from start to finish. Such success cannot be achieved without hard work by all concerned and capable stage management, and in this respect Mr. Arthur C. Chapman deserves great credit. The caste was as follows : Sir Joseph Porter, K.C.B. (First Lord of the Admiralty), Mr. Arthur C. Chapman ; Captain Corcoran (Commanding H.M.S. "Pinafore"), Mr. T. H. Green ; Ralph Rackstraw (Able Seaman), Mr. N. A. Merriman ; Dick Deadeye (Able Seaman), Mr. Charles Howard ; Bill Bobstay (Boatswain's Mate), Mr. R. E. Dickinson ; Bob Becket (Carpenter's Mate), Mr. Ernest Webb ; Tom Tucker (Midshipmite), Miss L. Lancaster ; Josephine (The Captain's Daughter), Miss Marjorie Fraser ; Hebe (Sir Joseph's First Cousin), Miss Clara Barnes ; Little Buttercup (A Portsmouth Bumboat Woman), Miss Alice White. First Lord's Sisters, Cousins, Aunts : The Misses Beatty, Boreham, Cherry, Croydon, Green, Groves, Hills, Hughes, Lintern, Meacock (Mrs.) Payne, Smith, Spencer, Stoddart, Telfer, Tilley, Watson, Wedgwood, Wheway, Winter, Witt. Sailors : Messrs. Bantoft, Blythe, Field, Griffiths, Parkinson, Rolph, Sanderson, Southwood, Tapster, Truss, S. Webb, Wiltshire. Marines : Messrs. Bishop, Copping, Smith, Warby. Mr. D. H. F. Meacock, the enthusiastic Hon. General Secretary of the London and North Western (London) Athletic Club, of which the Dramatic and Operatic Society is a branch, was responsible for the general management, and he was ably assisted by the stewards, Messrs. Boreham, Carter, Harding, E. Neville Harris, Petty, Phillp, Slough, Tucker and Wetherell. The Committee consists of Mr. Arthur C. Chapman, chairman (engineer's dept.) and Messrs. A. F. H. Bayston (booking office), T. Carter (account's, Camden), T. H. Green (goods rates), J. W. Harris (superintendent of line's), D. H. F. Meacock (general manager's), and A. S. Parker (hotel accounts, expenditure). The hon. secretary (pro tem.) of the Society is Mr. C. E. A. Howard, 7, Euston Square, N.W. The scenery had been specially painted by Mr. George E. Toplis. We are glad to hear that the two performances, which were well attended, realised a substantial sum for charitable purposes. Two further performances have since been given at Chelsea Barracks to soldiers and wounded men.

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UNDER the conductorship of Lieut.-Col. W. J. Galloway the Great Eastern Railway Musical Society has given further concerts to His Majesty's forces. On April 8th a visit was paid to the Empire Theatre at Southend-on-Sea, which was filled by the men of the 92nd Infantry Brigade (Rifles), and on April 13th a return concert was given at the White City in the large hall of the Y.M.C.A. On April 16th a further concert was given to the West Ham Battalion in the Stratford Town Hall. The Society's Male Voice Choir and Orchestra have had the valuable assistance of Miss Annie Bartle, Miss Gertrude Blomfield, Miss May Stevens, Mr. Ben Davies (who very kindly gave his services on two occasions), Mr. Thorpe Bates, Mr. Walter Barker, and Mr. Will Edwards. We may mention that the hon. conductor, Lieut.-Col. W. J. Galloway (East Lancashire Royal Engineers), has been appointed temporary Major in the Army, with the rank of Deputy-Quartermaster-General. Lord Claud Hamilton, M.P., the Society's President, has closely watched this concert work and encouraged it by his personal attendance.

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CAPT. H. E. O'BRIEN, Assistant Chief Mechanical Engineer, Lancashire and Yorkshire Railway, Horwich, has been appointed to the command of the 111th Company Railway Troops, Royal Engineers, attached to the British Expeditionary Force for France. He was educated at Eton and the Victoria University, Leeds, and received his engineering training with Messrs. Kitson & Co., Airedale Foundry, Leeds, on the Dublin and South Eastern Railway as a pupil of Mr. R. Cronin, and finally at Horwich as a pupil of Mr. Aspinall. After experience in several Departments of the Lancashire and Yorkshire Railway, Capt. O'Brien was appointed in 1903 engineer for electric traction, and took charge of the electrification of the Liverpool and Southport line, where he was responsible to the Chief Mechanical Engineer for the operation and upkeep of the power house, sub-stations, track equipment and rolling stock. In 1909 Capt. O'Brien was appointed Carriage and Wagon Superintendent at Newton Heath, and in 1910, on the promotion of Mr. J. P. Crouch (now Chief Mechanical Engineer of the Central Argentine Railway) to Passenger Superintendent of the Lancashire and Yorkshire, Capt. O'Brien was appointed to the position of Assistant Mechanical Engineer and Works Manager at Horwich.

CAPT. H. E. O'BRIEN.
Assistant Chief Mechanical Engineer, Lancashire and Yorkshire Railway.
Now in command of the 111th Company, Railway Troops, Royal Engineers.

* *

AT the last quarterly meeting of the Goods Managers' Conference of the Railway Clearing House Mr. J. E. Hennell, who recently retired from the service of the Great Western Company, was presented with a silver tray and a silver Tudor coffee pot, the former bearing the following inscription: "Presented to J. E. Hennell, Esq., by the Goods Managers' Conference on his retirement from the position of assistant goods manager of the Great Western Company, January, 1915." Mr. Robinson (Glasgow and South Western Company) made the presentation, and Mr. E. A. Evans made further appreciative remarks.

ON April 14th a gold watch and chain were presented to Mr. J. P. Thomas (formerly Superintendent of the Line, London Electric, Central London, and City and South London Railways, and now general superintendent of the London General Omnibus Company) by the inspectors, stationmasters, and clerical staff of the Tube Railways as an expression of their esteem and good wishes. Mr. W. E. Blake (who succeeds Mr. Thomas as Superintendent of the Tube Railways, in addition to his own position in charge of traffic working on the District Railway) made the presentation.

* *

THE death is announced of Mr. Reginald Wigram, a Director of the Great Northern Railway Company, at the age of seventy. He was a son of Mr. Money Wigram, a Director of the Bank of England, and a shipbuilder on the Thames at Blackwall. After a short experience of marine work, he spent some time in the works of the London and North Western Railway Company at Crewe.

* *

MR. FRANK R. POTTER has been appointed Superintendent of the new Division at Westbury created by recent changes in Great Western district organisation. He entered the service in 1895 as a clerk at West Drayton and Yiewsley station, and was, in 1897, transferred to the Divisional Superintendent's Office at Paddington, where he was engaged, with the exception of about seven months spent at Windsor, until 1907. In that year he was appointed Passenger Train Runner in the Office of the Superintendent of the Line. From 1911 to 1913 he was Assistant Divisional Superintendent at Plymouth, being removed to the London Division in a similar position, in the latter year, where he remained until his appointment at Westbury.

* * *

AT a meeting of the Mineral Managers' Conference, Mr. J. Rawson, late Mineral Manager,

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Midland Railway, was presented with a centre-piece and pair of vases of Crown Derby china, the stand supporting the centre-piece bearing the following inscription :—" Presented to John Rawson, Esq., by the members of the Northern Railway Companies' Mineral Managers' Conference on his retirement, December, 1914, as a token of esteem, and in recognition of the valuable services rendered by him during the twelve years of his membership."

* * *

MR. W. THOMAS, Chief of the Expenditure Department, London and North Western Railway, having retired after fifty-one years' service, has been succeeded by Mr. Charles Chitty, well known to the staff as the secretary of the Superannuation Fund and Widows and Orphans' Society. Mr. Chitty will continue his hotel work and to act as secretary of the Superannuation Fund and the Widows and Orphans' Society, but is relinquishing the secretaryship of the London and North Western and Great Western Joint Committee, to which he was appointed in October, 1910.

* * *

MR. G. EASTWOOD, the new General Manager of the Uganda Railway, was born on June 16th, 1863, educated at Fleetwood, and on March 13th, 1877, when under 14 years of age, was taken on in the Fleetwood office of John Aird & Sons, now known as Sir John Aird & Co., the well-known contractors. In 1878 he was engaged as Storekeeper at the Fleetwood Locomotive depôt on the Lancashire and Yorkshire Railway, but rejoined his first employers after twelve months. In 1897 Mr. Eastwood was recommended as Chief Accountant for the Uganda Railway, and now, after 18 years' service in the Protectorate, he has been selected for the premier position on the Uganda Railway, a line offering great possibilities, and one where there will be special scope for the capabilities of the new chief executive officer.

* * *

MAJOR-GEN. SIR PERCY GIROUARD, who has resigned his seat on the Board of Sir W. G. Armstrong, Whitworth and Co., Ltd., Elswick, and who now ranks as temporary Major-General, was appointed Director-General of all the Egyptian railways after his work in the Sudan. He entered the Army in 1888, was in the Dongola Expedition of 1896 and the Nile Expedition of 1897, was railway traffic manager at Woolwich Arsenal, 1890-95, and after his work in the Sudan and Egypt he was director of railways in the South African War.

* * *

APPLICATION is being made to Parliament by the City and South London, Central London, London Electric and Metropolitan District Railway Companies for leave to bring in a bill whereby agreements may be made between themselves and with the London General Omnibus Co., Ltd., for and with respect to the interchange routing and working of passenger traffic carried on the respective railways and the omnibuses owned or worked by the London General Omnibus Co., Ltd., the issue of through or alternatively routed tickets and the application of the receipts into a common fund, after prescribed payments. The bill sets forth arrangements necessary for carrying out the policy outlined, and also covers a number of other matters associated therewith, and for other purposes.

* * *

BY becoming an incorporated Society the Railwaymen's Welfare Association has taken a step which will do much in securing permanence and stability. As many RAILWAY MAGAZINE readers are aware, its headquarters are at the Railwaymen's Institute, 4 and 6, Bath Bridge, Bristol, where a good work for the benefit of both the souls and bodies of railwaymen has long been in progress. Under the articles of association, Mr. George A. Willis, J.P., is the first President, and he is supported by an influential and representative body of Vice-Presidents. One of the directors is Miss Emma Saunders, and her portrait is given below. Miss Saunders for something like 40 years has devoted herself to a special work amongst the railwaymen of Bristol and the surrounding district. By her constant interest in their welfare she has earned for herself the title of "The Railwaymen's Friend"; by her life, her example, and her work, she has endeared herself

MISS EMMA SAUNDERS.
"The Railwaymen's Friend."

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to all who have been privileged to know her. The simple unostentatious work initiated so many years ago, has developed with the progress of time into a movement of widespread influence and national importance for promoting religious, temperance, social, educational and institutional work amongst the railwaymen of the United Kingdom.

* * *

To commemorate the growth of the Railway Clerks' Association and the removal of the headquarters to new offices at 25, Euston Road, London, N.W., a gathering of the executive members and friends was held on May Day. After the inspection of the new premises a dinner was held at a restaurant in King's Cross under the chairmanship of Mr. Herbert Romeril. In an interesting speech Mr. Walkden gave the history of the association. Formed in Sheffield on May 8th, 1897, it just escaped an early death, for it was only decided to continue it by a vote of five to four. In November, 1898, the headquarters were removed to Nottingham, while in July of the following year a further removal was made to Doncaster. Till that time it was only a small provincial organisation. After various vicissitudes it came to London in July, 1906. It was then that Mr. Walkden took up the position of General Secretary. At that time there were 60 branches, with a total membership of only 4,000. By 1912 there were 150 branches, with a membership of 17,000. Since then the membership has doubled, and there are 240 branches, with 34,000 members—a record it would be hard to equal.

* * *

THE Metropolitan Railway are replacing their station name boards throughout the line by signs consisting of enamelled plates 6 feet 6 inches square, with bold black lettering over a red diamond. These are designed to catch the eye of passengers, and should go far to remove the reproach so often levelled against British railways, though with less justice than formerly, that the name of a station is the least distinctive of all the signs exhibited. These signs will also be more numerous than the name boards they displace.

* * *

NEW posters published by the UndergrounD Electric Railways include several features of interest. A large one depicting "Springtime" was drawn direct on to the stone by Mr. H. Becker, while the "Zoo" poster, an exceptionally artistic one, is the work of Mr. Semoto, a Japanese artist. Others include a stirring patriotic bill entitled "The Only Road for an Englishman"—drawn by Mr. G. Spenser Pryse—and a work entitled "Rest," which is intended to explain the idea outlined by the larger "Springtime" poster. These bills are now to be seen on most UndergrounD stations and are attracting a good deal of attention by reason of their originality and good workmanship.

AN "UNDERGROUND" ROLL OF HONOUR.

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A PHOTOGRAPH is reproduced showing the Roll of Honour of the members of the Headquarters Staff of the UndergrounD Electric Railways and London General Omnibus Co. who are serving in connection with the war.

* * *

FIVE new six-wheeled coupled goods locomotives are being constructed by Messrs. Beyer, Peacock and Co., Ltd., for the Cambrian Railways, to the designs of Mr. Herbert E. Jones, locomotive superintendent. These are generally similar to others built for the Company by the same firm in 1908. They will have cylinders 18 in. by 28 in.; diameter of wheels, 5 ft. 1½ in.; firebox heating surface, 110·7 sq. ft.; 1¼ in.

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tubes; heating surface of tubes, 1,131 sq. ft.; total heating surface, 1,241·7 sq. ft.; grate area, 20·5 sq. ft. The tenders will carry 2,500 gals. of water. The Cambrian Company are also, as an experiment, converting into a tender engine one of six second-hand tank engines purchased from the Metropolitan Railway, with a view to their more general use.

* * *

"METRO-LAND" is the title adopted for a new booklet issued by the publicity department of the Metropolitan Railway. It has been issued with the object of bringing the Londoner into closer acquaintance with the lovely districts rendered so easily accessible by Metropolitan, and as regards the joint lines, by Metropolitan and Great Central trains. There are numerous four-colour and other illustrations, maps, etc., and the letterpress is well and interestingly written. Copies can be obtained at booking offices and bookstalls or direct from the Commercial Manager at Baker Street station.

* * *

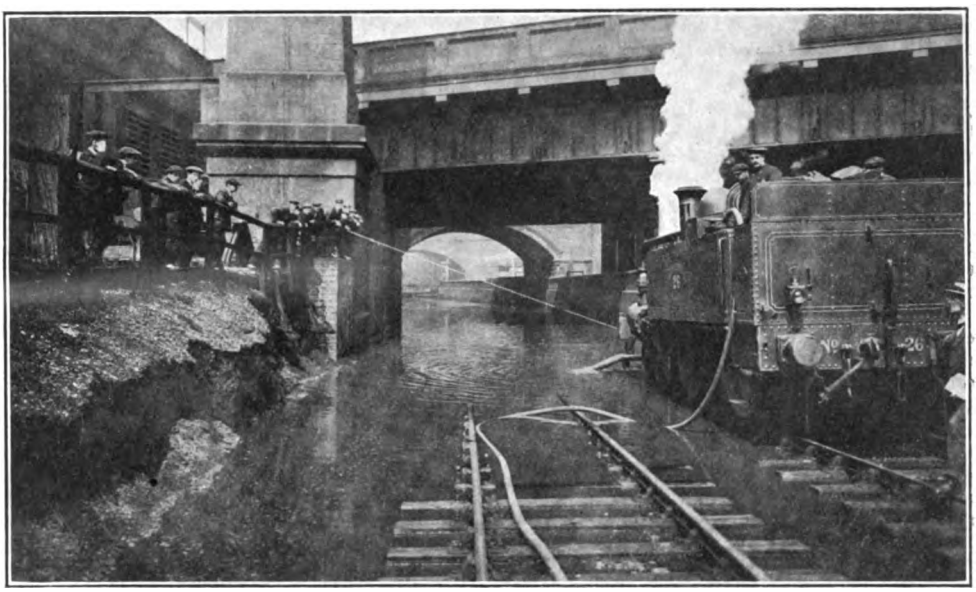
AT the meeting of the Railway Club on Tuesday, May 11th, Mr. G. W. J. Potter exhibited a collection of early railway maps and from an apparently academic and relatively dry subject—except as regards the enthusiastic railway student—gave an exceedingly interesting and instructive address, subsequent discussion eliciting many other facts. On June 8th, Mr. W. R. S. Smart, of the Model Railway Club, will read a paper on "The Aim of the Model Railwayist."

* * *

LONDON Electric trains which, since the opening of the Queen's Park Extension, have connected with London and North Western local trains at Queen's Park, have been extended to supply a fifteen-minute service onwards to Willesden Junction (New Station), using London and North Western metals, the equipment of which is now sufficiently advanced to permit of this. The new development will add very greatly to the inter-communication facilities, as at Willesden Junction connection can be made with nearly all London and North Western trains, express, slow main line, or local.

* * *

ALTHOUGH one cannot, under present conditions, take advantage of the Whitsuntide holidays to the same extent as hitherto, there is no reason why one should not utilise the few days' respite from business to recuperate health and energy at the South Coast, which offers an excellent substitute for the Continental resorts not now available. An excellent testimony to the recuperative qualities and tonic of the air is the fact that the splendid Indian and other brave troops are now undergoing treatment at Brighton and other South Coast Towns with gratifying results. Brighton, Worthing, Seaford, Eastbourne, Bexhill, St. Leonards, Hastings, Littlehampton, Bognor, Southsea, Portsmouth and the Isle of Wight are making special efforts to satisfy their patrons by providing good music and other attractions suited to the circumstances of the present time. Their close proximity to the Metropolis makes these towns particularly convenient for any who feel, for various reasons, that they must be near London. The Brighton Company announce that at their West End Offices,



PUMP-FITTED METROPOLITAN RAILWAY LOCOMOTIVE DEALING WITH THE FLOODING OF THE "WIDENED" LINES BETWEEN FARRINGDON ST. AND KING'S CROSS, MAY 7TH AND 8TH.

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28, Regent Street, Piccadilly, ordinary tickets to all parts of the line can be obtained at the same fares as charged at London Bridge and Victoria. Similar tickets at the same fares may also be obtained at the usual Ticket Agencies. Extra trains will be run from London Bridge, Victoria, etc., to the South Coast towns on Friday and Saturday, May 21st and 22nd.

* * *

THE Strand station of the "Piccadilly" section of the London Electric Railway is now known as "Aldwych," and the Charing Cross (Strand) station of the Hampstead line as "Strand" (for South Eastern and Chatham Railway). This step has been taken in order to differentiate between the Underground station serving the Charing Cross of the South Eastern and Chatham Railway, and the Underground stations on the Bakerloo and Hampstead lines serving the District Railway, as many visitors unacquainted with tube travel in London confused the two points of exchange.

* * *

A NEW locomotive depôt has been brought into use by the North British Railway, at Polmont Junction, on the Edinburgh and Glasgow main line, about 3 miles to the east of Falkirk. There is a commodious engine shed of modern design, coaling stage, water tank, engine turntable, offices, stores, bothies, etc. The engine shed has five roads, which can each accommodate four of the largest "Atlantic" type locomotives at one time. Under each road a pit extends for the entire length. At the north side of the shed is a store for lighting and lubricating oils, and engine parts for repairs and renewals, waste, etc. A 60 ft. diameter turntable, by Messrs. Cowans, Sheldon & Co., is placed near the shed, and it enables the largest locomotives, weighing, in working order, 119¾ tons, to be dealt with. About 40 engines are attached to the depôt, which is situated in a very busy commercial and mining district nearly midway between Edinburgh and Glasgow. The depôt takes the place of that formerly situated at Bo'ness Junction, about 2 miles further east on the Edinburgh and Glasgow main line, and its construction involved a capital expenditure of, approximately, £20,000.

* * *

DURING the terrific storm on Thursday, May 6th, the sewer under the "widened" lines between Farringdon Street and King's Cross on the Metropolitan Railway became choked, with the result that the low-level tunnel under the electrically equipped lines, used by Great Northern and Midland passenger trains, and by many goods and special trains, became filled with water and the traffic on this section of the line had to be suspended until the water could be pumped out. The Metropolitan Railway have had previous trouble in this direction, and in order to cope with another emergency a pump had been constructed to be attached to the front buffer beam of any of their locomotives as shown in the illustration reproduced on page 499. This pump is capable of raising 700 gallons of water per minute, but in addition several fire engines mounted on flat trucks were employed. It was not, however, until the Sunday that the work was completed, and meanwhile communication was entirely interrupted between the Midland and Great Northern Railways and the southern lines, though normally, and more markedly still since the outbreak of war, an enormous goods and mineral traffic is worked over these lines.

* * *

A REVISED service of boats between Portsmouth and the Isle of Wight is now in operation, giving seven connections from Portsmouth on week-days and four on Sundays, with two week-day and one Sunday service from Southsea to Ryde, while the other way there are eight services to Portsmouth on week-days and one to Southsea, with three to Portsmouth and one to Southsea on Sundays. On the Lymington route there are five week-day crossings each way.

* * *

THE latest recruiting appeal to be issued by the London General Omnibus Company takes the form of a striking and original form of panel bill with the words:

Follow the 'Buses to the Front.
THE BEST COUNTRY ROUTE
OF THE YEAR FOR MEN.
By 'Bus to the Trenches. Start Now.

This slip, the colour scheme of which is black, yellow, and light blue, is displayed conspicuously on the "General" 'buses, with the result, it is hoped, of further stimulating recruiting and impressing the public at large with the great need there is for an adequate supply of men.

* * *

IN connection with the electrification of the suburban lines of the London and South Western Railway, a new passenger station is about to be constructed at Barnes Bridge, on the Surrey side of the river, and more convenient than the present station at Barnes Common in regard to communication with the riverside. Booking hall and offices will be erected at road level, with a frontage to the terrace.

* * *

EXTENSIVE alterations have been effected in connection with the engine turntable at Exmouth Junction, London and South Western Railway, in order to render it capable of dealing with, and facilitating the balancing of, the heaviest and largest engines. The table has been lengthened from 55 ft. to 65 ft. and strengthened, and also fitted with improved locking gear, which brings its capabilities up to date with the other large depôts.

* * *

TEMPLE station, District Railway, is being reconstructed. In many ways this was very inconveniently designed, and in its new form the booking hall will have the offices in suitable position to avoid conflicting passenger movements, while one set of gates will suffice, except in times of pressure, for the entrance and exit of passengers travelling in either direction.

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